CITY OF San Dimas CALIFORNIA

NATURAL HAZARD MITIGATION PLAN

March 2005

Special Thanks & Acknowledgments

The City of San Dimas would like to thank the following participants in the completion of the Natural Hazard Mitigation Plan.

Project Steering Committee:

- City of San Dimas Administrative Services
- City of San Dimas Building and Safety Division
- City of San Dimas Community Development
- City of San Dimas Planning Commission
- City of San Dimas Public Safety Commission
- City of San Dimas Chamber of Commerce
- City of San Dimas Historical Society
- Bonita Unified School District
- Residents of the San Dimas Community
- Office of Disaster Management, Area D: Brenda Hunemiller, Coordinator

Project Technical Committee:

- Ken Duran, Assistant City Manager, City of San Dimas
- Carl Flores, Battalion Chief, County of Los Angeles Fire Department
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Eric Beilstein, Superintendent, Building and Safety, City of San Dimas
- Joe Vacca, Associate Planner, City of San Dimas
- John Lee, Administrative Aide, City of San Dimas
- Lynn Kelly, Administrative Intern, City of San Dimas

Project Advisory Committee:

- Ken Duran, Assistant City Manger, City of San Dimas
- David Bratt, Planning Commission, City of San Dimas
- Neil Oudejans, Public Safety Commission, City of San Dimas
- Robert Anderson, Public Safety Commission, City of San Dimas
- Paul Rippins, City of San Dimas Historical Society
- Eileen Mullen, Bonita Unified School District
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Laura Nash, City of San Dimas Community at Large
- Scott Dilley, Chamber of Commerce, City of San Dimas

Project Manager:

- Ken Duran, Assistant City Manager, City of San Dimas

Table of Contents

Maps, Tables, & Figures

Executive Summary

Several years ago, Congress established the Disaster Mitigation Act of 2000 to reinforce the importance of mitigation planning in both pre- and post-disaster situations. This act mandated all local governments develop, adopt, and implement a Natural Hazard Mitigation Plan in order to be eligible for federal funding. California cities have until November 2004 to submit a plan to the Federal Emergency Management Agency (FEMA).

The City of San Dimas Natural Hazard Mitigation Plan (NHMP) includes resources and information to assist City residents, public and private sector organizations, and others interested in participating in planning for natural hazards. The plan details five major hazards that affect the Southern California region and assesses their potential risk. The mitigation plan also provides a list of activities that may assist the City in reducing risk and preventing loss from future natural hazard events. The action items address multi-hazard issues, as well as activities for earthquakes, earth movements, flooding, wildfires, and windstorms.

Who Participated in Developing the Plan?

The City of San Dimas Natural Hazards Mitigation Action Plan is the result of a collaborative effort between residents, public agencies, non-profit organizations, the private sector, and regional and state organizations. Public participation played a key role in development of goals and action items. San Dimas residents were invited to participate in public meetings and provide feedback through a survey to assist in plan development. Project Steering, Technical, and Advisory Committees were formed and played crucial roles in guiding the process and development of the plan. Their roles are described in detail later in this plan.

The Steering Committee:

- City of San Dimas Administrative Services
- City of San Dimas Building and Safety Division
- City of San Dimas Community Development
- City of San Dimas Planning Commission
- City of San Dimas Public Safety Commission
- City of San Dimas Chamber of Commerce
- City of San Dimas Historical Society
- Bonita Unified School District
- Residents of the San Dimas Community
- Office of Disaster Management, Area D: Brenda Hunemiller, Coordinator

Project Technical Committee:

- Ken Duran, Assistant City Manager, City of San Dimas
- Carl Flores, Battalion Chief, County of Los Angeles Fire Department

- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Eric Beilstein, Superintendent, Building and Safety, City of San Dimas
- Joe Vacca, Associate Planner, City of San Dimas
- John Lee, Administrative Aide, City of San Dimas
- Lynn Kelly, Administrative Intern, City of San Dimas

Project Advisory Committee:

- Ken Duran, Assistant City Manger, City of San Dimas
- David Bratt, Planning Commission, City of San Dimas
- Neil Oudejans, Public Safety Commission, City of San Dimas
- Robert Anderson, Public Safety Commission, City of San Dimas
- Paul Rippins, City of San Dimas Historical Society
- Eileen Mullen, Bonita Unified School District
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Laura Nash, City of San Dimas Community at Large
- Scott Dilley, Chamber of Commerce, City of San Dimas

What is the Plan Mission?

The mission of the City of San Dimas NHMP is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities for building a safer community.

What are the Plan Goals?

The plan goals describe the overall direction that San Dimas agencies, organizations, and citizens can take to work toward mitigating risk from natural hazards. These goals are stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items.

Protect Life and Property

- Implement activities that assist in protecting lives and property by making homes, businesses, infrastructure, and critical facilities more resistant to losses from natural hazards.

- Reduce losses and repetitive damages from chronic hazard events and promoting insurance coverage for catastrophic hazards.

- Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventive measures for existing development in areas vulnerable to natural hazards.

Increase Public Awareness

- Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards to minimize the loss of life and property.

- Provide informational items, partnership opportunities, and funding resource information to assist in implementing mitigation activities.

Strengthen Partnerships

- Strengthen communication and coordinate participation among public agencies, residents, non-profit organizations, business, and industry to provide a guidance in the implementation of mitigation measures.

- Encourage and support leadership within the private sector, non-profit agencies, and community based organizations to promote and implement local hazard mitigation activities.

City Emergency Services

- Establish policy to ensure the importance of mitigation programs and projects for critical facilities, services, and infrastructure.

- Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.

- Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Environmental & Historical Preservation

- Balance land use planning with natural and manmade hazard mitigation to protect life, property and the environment.

How are the Action Items Organized?

Action items are activities in which City agencies and citizens can be engaged to reduce risk. Short-term action items are activities that City agencies may implement with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between two and five years (or more) to implement. Ongoing activities occur continually throughout the implementation process.

San Dimas is currently involved in a number of mitigation activities designed to alleviate the effects of natural hazards on residents and critical infrastructure. These initiatives include:

- Supplying various locations with free sandbags and sand
- Requiring soils engineers reports for all new construction
- Monitoring brush clearance
- Requiring all new residential developments in Fire Zone 4 to go through a plan check by the Los Angeles County Fire Department and the City of San Dimas
- The Design and Review Board reviews site plan design, building materials, and landscaping
- Trimming city-owned trees

The action items are organized by the following subsections, which includes all multi-hazard and hazard-specific action items in the mitigation plan. Data collection, research and the public participation process resulted in the development of these action items (see Appendix B).

Coordinating Organization: The coordinating organization is the public entity with regulatory responsibility to address natural hazards, and is willing and able to organize resources, and find appropriate funding. This agency must also be capable of the oversight of implementation, monitoring, and evaluation. Coordinating organizations may include local, county, or regional agencies that are responsible for implementing programs.

Time Line: Action items include short, long-term, and ongoing activities. Short-term action items are activities which City agencies are capable of implementing with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between two and five years (or more) to implement. Ongoing activities occur continually throughout the implementation process.

Initiatives for Implementation: Each action item includes the initiatives that the City determined as the most beneficial and effective methods for implementing the action item.

Plan Goals Addressed: The plan goals addressed by each action item are included as a way to monitor and evaluate how well the mitigation plan is achieving its goals once implementation begins. The plan goals are organized into the following five areas:

1. Protect Life and Property
2. Public Awareness
3. Natural Systems
4. Partnerships and Implementation
5. Emergency Services

Partner Organizations: Partner organizations may not be listed with the individual action items or in the plan matrix, but can be found in Appendix A. These organizations are agencies that can assist in the implementation by providing relevant resources to the coordinating organization.

Natural Hazard Mitigation Action Items

Hazard 1: Earthquakes

Action Item 1.1: Educate and assist the public on earthquake preparedness.
Implementation Initiatives:

Implementation Initiative 1.1.1 Conduct a community wide earthquake preparedness exercise.

Implementation Initiative 1.1.2 Educate the public on the availability of the California Earthquake Insurance Program.

Implementation Initiative 1.1.3 Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, and businesses.

Coordinating Organizations: City Administration Department, Los Angeles County Sheriff's Department, City Building and Safety Division
Time line: Short-term, Ongoing.
Plan Goals Addressed: Increase public awareness.

Action Item 1.2: Enhance the sustainability of a functioning government during and after an earthquake.
Implementation Initiatives:

Implementation Initiative 1.2.1 Identify alternative structures to house government agencies.

Implementation Initiative 1.2.2 Encourage seismic strength evaluations of Civic Center buildings.

Coordinating Organizations: City Administration Department, City Building Division
Time line: Short-term.
Plan Goals Addressed: Strengthen City emergency services.

Action Item 1.3: Increase the number of retrofitted private structures.
Implementation Initiatives:

Implementation Initiative 1.3.1 Promote incentives, such as waiving permit fees, for retrofitting unreinforced or unanchored residential foundations.

Implementation Initiative 1.3.2 Evaluate an unreinforced masonry ordinance.

Implementation Initiative 1.3.2 Identify funding sources for structural and non-structural retrofitting of buildings that are identified as seismically vulnerable.

Coordinating Organizations: City Building Division, City Administration Department
Time line: Long-term.
Plan Goals Addressed: Protect life and property; Environmental and historical conservation.

Hazard 2: Landslide

Action Item 2.1: Provide education outreach on the dangers of potential landslides.
Implementation Initiatives:

Implementation Initiative 2.1.1 Provide information on vegetation and rodent control on slopes.

Coordinating Organizations: City Public Works Department
Time line: Short term.
Plan Goals Addressed: Increase public awareness.

Action Item 2.2: Increase emergency preparedness specific to landslides.
Implementation Initiatives:

Implementation Initiative 2.2.1 Continue to supply various locations with free sandbags and sand.

Implementation Initiative 2.2.2 Maintain the existing stockpile of k rails and update staging plans

Implementation Initiative 2.2.3 Develop an evacuation plan for Sycamore Canyon Equestrian Center.

Implementation 2.2.4 Maintain a database of debris basins from LA County Public Works and monitor the ongoing threat of sediment overflow.

Implementation 2.2.5 Include a USGS layer on GIS system to maintain a database of properties subject to landslide liquefaction.

Implementation 2.2.6 Develop an Action Plan to address the risk of isolation for residents in San Dimas Canyon because evacuation routes may be blocked by landslides.

Coordinating Organizations: City Public Works Department, Los Angeles County Sheriff's Department, City Administration Department
Time line: Short-term
Plan Goals Addressed: Strengthen City emergency services; Protect life and property.

Action Item 2.3: Reduce the risk of landslides in San Dimas Canyon, Sycamore Canyon and Hamm's Canyon.
Implementation Initiatives:

Implementation Initiative 2.3.1 Continue to require soils engineer's reports for new construction.

Implementation Initiative 2.3.2 Evaluate the potential for upgrade or replacement of identified bridge crossings.

*Implementation Initiative 2.3.3*Evaluate the potential for street intersection upgrades at Sycamore Canyon Road and San Dimas Canyon Road.

Coordinating Organizations: City Public Works Department
Time line: Long-term
Plan Goals Addressed: Protect life and property.

Action Item 2.4: Mitigate post fire debris flow.
Implementation Initiatives:

Implementation Initiative 2.4.1 Continue to supply various locations with free sand and sandbags.

Implementation Initiative 2.4.2 Continue to maintain the stockpile of k rails and update staging plans.

Implementation Initiative 2.4.3 Amend lease agreements with private property owners for the continued placement of trash racks in the canyons. Continue to monitor and maintain the trash racks.

Implementation Initiative 2.4.4 Monitor existing capacities and sediment flows with LA County Public Works.

Coordinating Organizations: City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Strengthen City emergency services; Protect life and property.

Hazard 3: Flooding

Action Item 3.1: Mitigate private property losses due to floods.
Implementation Initiatives:

Implementation Initiative 3.1.1 Encourage residents to participate in the flood hazard insurance program.

Implementation Initiative 3.1.2 Continue to monitor brush clearance in open channels and debris basins on private property.

Implementation Initiative 3.1.3 Educate residents on the importance of proper brush clearance.

Coordinating Organizations: City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Protect life and property; Increase public awareness.

Action Item 3.2: Enhance data and mapping for flooding information within the City. Identify and map flood-prone areas.
Implementation Initiatives:

Implementation Initiative 3.2.1 Develop and implement GIS system to map flood zones.

Coordinating Organizations: City Administration Department
Time line: Short.
Plan Goals Addressed: Protect life and property.

Action Item 3.3: Educate the public on the dangers and mitigation of post-fire flooding.
Implementation Initiatives:

Implementation Initiative 3.3.1 Create a public education program on sandbag techniques and other flood protection measures.

Coordinating Organizations: City Public Works Department, City Administration Department
Time line: Ongoing.
Plan Goals Addressed: Increase public awareness; Protect life and property.

Hazard 4: Wild Fire

Action Item 4.1: Modify building standards to reduce fire hazards in affected residences.
Implementation Initiatives:

Implementation Initiative 4.1.1 Continue to require all new residential developments in Fire Zone 4 to go through a thorough plan check by LA County Fire and the City of San Dimas.

Implementation Initiative 4.1.2 Continue to use the design and review board to review site plan design, building materials and landscape design.

Implementation Initiative 4.1.3 Continue to enforce the use non-combustible roof materials.

Implementation Initiative 4.1.4 Continue to enforce the zoning standard requiring a minimum separation requirement for structures in Specific Plan 25.

Implementation Initiative 4.1.5 Develop guidelines for a water availability assessment to be conducted for all new developments in Specific Plan 25

Coordinating Organizations: City Planning Department, City Public Works Department.
Time line: Ongoing, Short-term.
Plan Goals Addressed: Protect life and property; Environmental and historical preservation.

Action Item 4.2: Monitor the use of vacant parcels to reduce the risk and spread of fire.
Implementation Initiatives:

Implementation Initiative 4.2.1 Identify vacant parcels with problem vegetation and weeds.

Implementation Initiative 4.2.2 Maintain vigilant weed abatement enforcement and suggest replacement of brush with non-combustible vegetation.

Implementation Initiative 4.2.3 Coordinate efforts with Cal-Trans (and other agencies) regarding landscape clearance and replacement vegetation for perimeter areas.

Implementation Initiative 4.2.4 Encourage environmentally sensitive vegetation clearance techniques in hillside areas.

Coordinating Organizations: City Planning Department, City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Strengthen partnerships; Protect life and property; Environmental and historical preservation.

Action Item 4.3: Educate residents on the importance of brush clearance and hazards of fire.
Implementation Initiatives:

Implementation Initiative 4.3.1 Coordinate efforts with the Fire Department on conducting community fire safety expos.

Implementation Initiative 4.3.2 Educate the community on the Red Flag Warning System. Suggested outreach venues include the City newsletter, website, and public access channel.

Coordinating Organizations: Los Angeles County Fire Department, City Administration Department
Time line: Short-term
Plan Goals Addressed: Increase public awareness, Strengthen partnerships.

Hazard 5: Windstorms

Action Item 5.1: Educate the community on the dangers of windstorms and potential mitigation measures.
Implementation Initiatives:

Implementation Idea 5.1.1 Offer pruning and tree trimming education to residents.

Implementation Idea 5.1.2 Educate the community on voluntary upgrades to structures subject to wind damage. Place particular emphasis on mobile home park residents.

Coordinating Organizations: City Parks and Recreation Department, City Public Works Department
Time line: Short-term.
Plan Goals Addressed: Increase public awareness.

Action Item 5.2: Develop and implement programs to minimize the potential for city trees from threatening lives, property, and public infrastructure during windstorm events.
Implementation Initiatives:

Implementation Initiative 5.2.1 Develop a citywide tree inventory and maintenance monitoring system.

Implementation Initiative 5.2.2 Review tree-trimming frequency and practices for City trees.

Implementation Initiative 5.2.3 Develop a policy to evaluate the health of trees for possible proactive removal. Contract professional arborists to develop policies.

Coordinating Organizations: City Parks and Recreation Department
Time line: Short-term.
Plan Goals Addressed: Protect life and property; Environmental and historic preservation.

Action Item 5.3: Reduce the danger of structural damage to buildings along the Bonita Corridor
Implementation Initiatives:

Implementation Initiative 5.3.1 Evaluate the integrity of the facades of the buildings along the Bonita Corridor.

Implementation Initiative 5.3.2 Develop an Action Plan to encourage upgrades to sub-standard facades along the Bonita Corridor.

Coordinating Organizations: City Public Works Department, City Planning Department
Time line: Long-term.
Plan Goals Addressed: Protect life and property.

Hazard 6: Multi-Hazard

Action Item 6.1: Enhance data and mapping information within the City and identify and map hazard prone areas.
Implementation Initiatives:

Implementation Initiative 6.1.1 Develop a complete GIS system and provide training to all pertinent personnel.

Coordinating Organizations: City Administration Department
Time line: Short-term.
Plan Goals Addressed: Protect life and property.

Action Item 6.2: Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.

Implementation Initiatives:

Implementation Initiative 6.2.1 Educate the public about emergency sheltering and evacuation procedures.

Implementation Initiative 6.2.2 Collaborate with the Bonita Unified School District on educational natural hazard awareness programs.

Implementation Initiative 6.2.3 Place public information brochures related to mitigating natural hazards at the Senior Center, Teen Center, Library, and City Hall.

Coordinating Organizations: City Administration Department
Time line: Ongoing.
Plan Goals Addressed: Increase public awareness.

Action Item 6.3: Enhance and expand the City's emergency response capabilities.
Implementation Initiatives:

Implementation Initiative 6.3.1 Develop and offer a CERT programs to residents.

Implementation Initiative 6.3.2 Augment training of Emergency Response Teams.

Implementation Initiative 6.3.3 Develop an employee communication response plan.

Implementation Initiative 6.3.4 Consider the feasibility of appointing a dedicated Emergency Preparedness Coordinator.

Coordinating Organizations: City Administration Department, Los Angeles County Sheriff's Department
Time line: Short-term, Ongoing.
Plan Goals Addressed: Strengthen City Emergency Services; Protect life and property.

Action Item 6.4: Integrate the goals and action items from the City of San Dimas' Natural Hazard Mitigation Plan into existing regulatory documents and programs where appropriate.
Implementation Initiatives:

Implementation Initiative 6.4.1 Consider incorporating mitigation goals and action items into the Safety Element of the City of San Dimas General Plan when the General Plan is next updated.

Implementation Initiative 6.4.2 Continue to change the City Building Code, where appropriate, to reflect future changes to the California Building Code.

Coordinating Organizations: City Planning Department, City Building and Safety Division
Time line: Long-term, Ongoing.
Plan Goals Addressed: Strengthen partnerships.

Action Item 6.5: Identify and pursue funding opportunities to develop and implement local mitigation activities.
Implementation Initiatives:

Implementation Initiative 6.5.1 Monitor the State Hazard Mitigation Office at the California Office of Emergency Services for information on hazard mitigation funding.

Implementation Initiative 6.5.2 Monitor the Federal Emergency Management Agency for grant programs to implement mitigation goals.

Implementation Initiative 6.5.3 Identify organizations and agencies that may support mitigation activities.

Coordinating Organizations: City Administration Department
Time line: Ongoing.
Plan Goals Addressed: Strengthen partnerships.

Action Item 6.6: Develop a warning system to alert residents of potential hazards as well as provide post-disaster information.
Implementation Initiatives:

> *Implementation Initiative 6.6.1* Evaluate the feasibility of a communication system to send out a blanket call to residents warning them of potential hazards.

Coordinating Organizations: City Administration Department
Time line: Long-term.
Plan Goals Addressed: Increase public awareness; Protect life and property.

How Will the Plan be Implemented, Monitored, And Evaluated?

The plan maintenance section of this document details the formal process that will ensure the City of San Dimas NHMP remains an active and relevant document. The process includes an outline for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how City staff will integrate public participation throughout the process. Finally, there is a description of how the City intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City's General Plan, Capital Improvement Plans, and Building & Safety Codes.

Plan Adoption

Adoption of the Natural Hazard Mitigation Plan by City Council is one of the key requirements for approval of the plan. As the local governing body, City Council has the responsibility and authority to promote sound public policy regarding natural hazards. Staff will periodically re-adopt the plan as it is revised to meet changes in the risks and exposures in the community. The approved Natural Hazard Mitigation Plan will be significant in future growth and development of the community.

Coordinating Body

The Hazard Mitigation Advisory and Technical Committees will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The City Council will assign representatives from City agencies, including, but not limited to, the current Steering, Technical, and Advisory Committee members. The City Public Safety Commission will also take on a larger role in the implementation of the NHMP.

Convener

The Assistant City Manager will serve as a convener to facilitate the Hazard Mitigation Committee meetings, and will assign tasks such as updating and presenting the Plan to the members of the committees. Plan implementation and evaluation will be a shared responsibility among all of the committee members, as well as City Council.

Implementation through Existing Programs

The City addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans, and Building & Safety Codes. The Natural Hazard Mitigation Plan provides a series of recommendations that are closely related to the goals and objectives of these existing planning programs. The City will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

While the City of San Dimas does not have a particular funding source for the implementation of the NHMP, money is available through the General Fund. In addition, the City will actively seek competitive grants through organizations such as FEMA and the State of California.

Economic Analysis of Mitigation Projects

FEMA's approaches to identifying costs and benefits associated with natural hazard mitigation strategies or projects fall into two general categories: benefit-cost analysis and cost-effectiveness analysis. Conducting benefit-cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. A detailed description of the potential economic analysis process can be found in Appendix C.

Formal Review Process

The San Dimas NHMP will be evaluated on an annual basis to determine the effectiveness of programs, as well as reflect changes in land development or programs that may affect mitigation priorities. The evaluation process includes an approximate schedule and time line, and identifies the local agencies participating in plan evaluation. The convener will be responsible for contacting the Hazard Mitigation Committee members and organizing meetings. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan. Their duties are outlined further in Section 5.

Continued Public Involvement

The City of San Dimas is dedicated to involving the public directly in the continual review and updates of the Hazard Mitigation Plan. Copies of the plan will be catalogued and made available at City Hall and at all City operated public libraries. The existence and location of these copies will be publicized in City newsletters. The City Administration Department will be responsible for keeping track of public comments on the Plan. In addition, copies of the Plan and any proposed changes will be posted on the City website. This site will also contain an email address and phone number to which people can direct their comments and concerns.

1 Introduction

Throughout its history, the residents of Southern California and the City of San Dimas have dealt with various natural hazards affecting the area. Photos, journal entries, and newspapers from the 1800's show that residents were affected by earthquakes, landslides, flooding, wildfires, and windstorms. Although there were fewer people in the area, these natural hazards adversely affected the lives of those who depended on the land and climate conditions for food and welfare. As the population of the City and the region continues to rapidly increase, the exposure to natural hazards creates an even higher risk than previously experienced.

San Dimas is the 70th most populous city in Los Angeles County, and offers the benefits of living in a Mediterranean climate. The City is characterized by a unique and attractive landscape that makes the area popular. Its proximity to the beaches, mountains, and desert has attracted an increasing amount of people each year. However, potential impacts of natural hazards associated with the terrain make the environment and population vulnerable to natural disaster situations. While it is impossible to predict exactly when these disasters will occur, or the extent of their damage, with careful planning and collaboration among public agencies, private organizations, and citizens within the community, it is possible to minimize the losses that can result from these natural disasters.[1]

The City of San Dimas most recently experienced large-scale destruction during the Williams Fire in September 2002. Between September 22 and September 27, thousands of acres on the hillsides and canyons of San Dimas were destroyed. The damage to the businesses, residences, and infrastructure in San Dimas was approximately $201,960, and $10 million to the entire San Dimas Canyon. Over 37,000 acres of wild lands were destroyed, and hundreds of homes, recreation facilities, and local canyons were at risk. In total, the fires cost $16.4 million to fight and contain in the area.[2]

Following the Williams Fire, citizens of San Dimas were also at risk for landslides and debris flows that often result because of wild fires. The City sought federal assistance from the Natural Resources Conservation Services for its recovery effort including the installation of k-rails, sandbags, trash racks, debris removal, and selective channel clearing. FEMA also contributed funds to the region to help fight the fires. Fortunately, the City of San Dimas was successful in mitigating the effects of post-fire hazards through this careful and thorough planning.

Why Develop a Mitigation Plan?

The rising cost of natural disasters has led to a renewed interest in recognizing effective ways to reduce vulnerability to disasters. This mitigation plan will assist our community in reducing risk from natural hazards by identifying resources, information, and strategies for risk reduction, while helping coordinate mitigation activities throughout the City.

The plan provides a set of action items to reduce risk from natural hazards through education and outreach programs and to foster the development of partnerships, and implementation of preventative activities such as land use programs that restrict and control development in areas subject to damage from natural hazards.

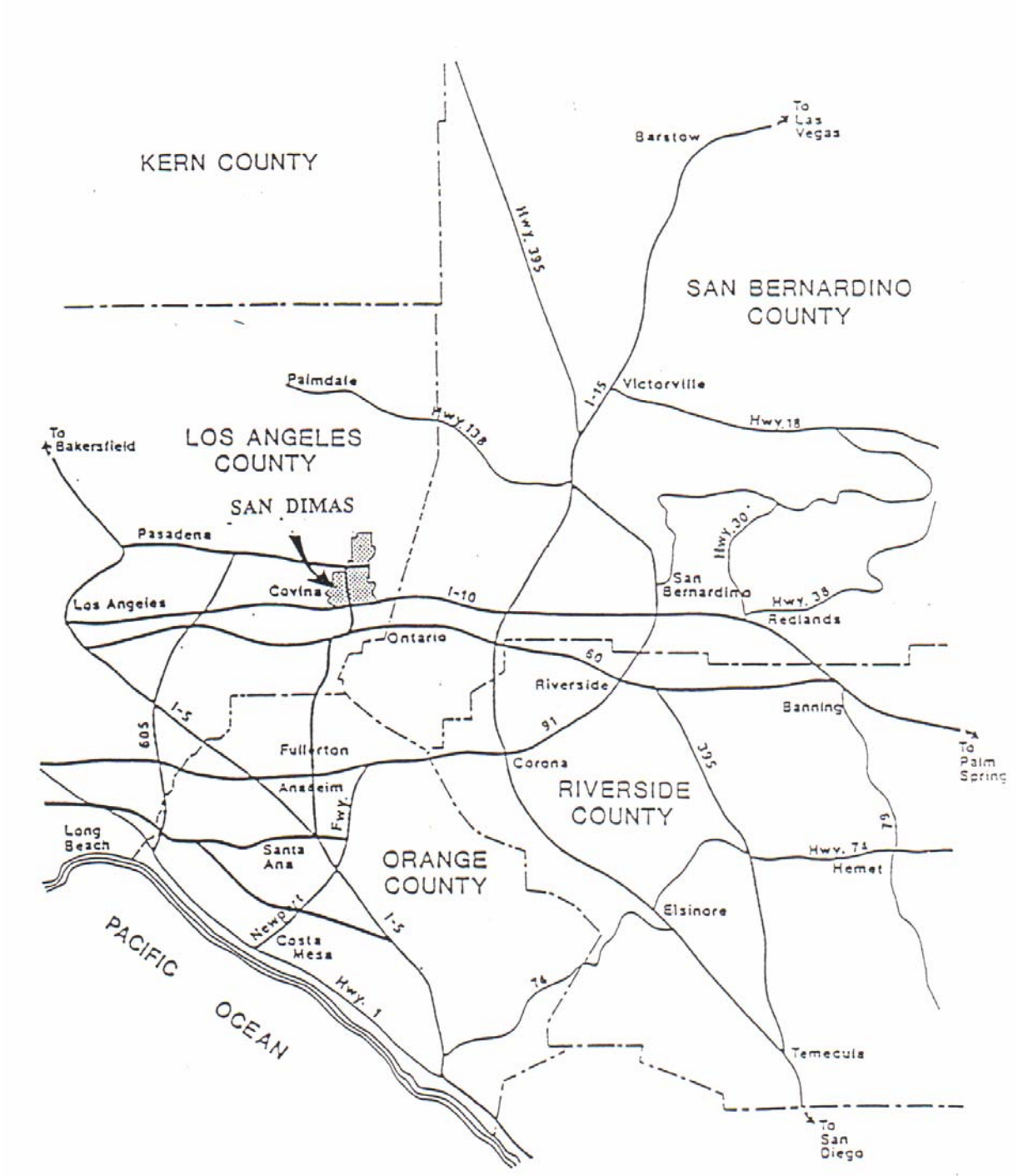
Numerous resources within the Mitigation Plan have been supportive in guiding the City throughout the planning process. They have established a basis for coordination and collaboration among agencies and the public in San Dimas, as well as identify and prioritize future mitigation projects. Finally, they have assisted in meeting the requirements of federal assistance programs.

For successful implementation of the Natural Hazard Mitigation Plan, it is essential that it work in conjunction with other City plans, including, but not limited to, the General Plan, Capital Improvements Plan, and Emergency Operations Plans.

Whom Does the Mitigation Plan Affect?

The City of San Dimas NHMP affects the entire city. The resources and background information in the plan is applicable Citywide, and the goals and recommendations can lay groundwork for local mitigation plans and partnerships. Map 1-1 shows the City of San Dimas as well as the surrounding areas.

Map 1-1 The City of San Dimas



**Map Not To Scale*

Natural Hazard Land Use Policy in California

Planning for natural hazards is an integral element of any city's land use planning program. All California cities and counties have General Plans and implementing ordinances that are required to comply with the statewide planning regulations. The continuing challenge faced by local officials is to keep the network of local plans effective in responding to the changing conditions and needs of California's diverse communities, particularly in light of the very active seismic region in which we live. This is especially true where communities must balance development pressures with detailed information on the nature and extent of hazards.

Planning for these hazards requires local plans to include inventories, policies, and ordinances to guide development in hazard areas. These inventories include the compendium of hazards facing the community, environment at risk, the personal property that may be damaged by hazards and most of all, the residents who live in the shadow of these events.

Support for Natural Hazard Mitigation

All mitigation is local; hence, the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. Nevertheless, these jurisdictions do not need to act alone. Available partners and resources exist at the regional, state, and federal levels. Numerous California state agencies have a role in natural hazard mitigation. Some of these key agencies include:

- **The Governor's Office of Emergency Services** (OES) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration.

- **The Southern California Earthquake Center** (SCEC) gathers information about earthquakes and communicates this to end-users and the general public to increase earthquake awareness, reduce economic losses, and save lives.

- **The California Division of Forestry** (CDF) is responsible for all aspects of wild land fire protection on private, state, and administers forest practices regulations on non-federal lands.

- **The California Division of Mines and Geology** (DMG) is responsible for geologic hazard characterization, public education, the development of partnerships aimed at reducing risk.

- **The California Division of Water Resources** (DWR) plans, designs, constructs, and operates, the State Water Project. The DWR is also responsible for the regulation of dams and the provision of flood protection and emergency management, and technical assistance.

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. Staff from the City of San Dimas conducted data research and analysis, facilitated Technical and Advisory Committee meetings and public workshops, and developed the final mitigation plan. The variety of research methods and various contributions are outlined below.

Input from the Committees

The Steering Committee assembled approximately every eight weeks to guide development of the Mitigation Plan. This Committee played an integral role in developing the mission, goals, and action items for the mitigation plan. The Committee consisted of representatives of public and private agencies and organizations throughout the City of San Dimas.

Project Steering Committee

- City of San Dimas Administrative Services
- City of San Dimas Building and Safety Division
- City of San Dimas Community Development
- City of San Dimas Planning Commission
- City of San Dimas Public Safety Commission
- City of San Dimas Chamber of Commerce
- City of San Dimas Historical Society
- Bonita Unified School District
- Residents of the San Dimas Community
- Office of Disaster Management, Area D: Brenda Hunemiller, Coordinator

A Technical Advisory Committee was formed to provide technical research and analysis and prepare the written plan. This committee held approximately seven meetings. The Technical Committee consisted of the following representatives:

Project Technical Committee

- Ken Duran, Assistant City Manager, City of San Dimas
- Carl Flores, Battalion Chief, County of Los Angeles Fire Department
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Eric Beilstein, Superintendent, Building and Safety, City of San Dimas
- Joe Vacca, Associate Planner, City of San Dimas
- John Lee, Administrative Aide, City of San Dimas
- Lynn Kelly, Administrative Intern, City of San Dimas

An Advisory Committee was formed in order to coordinate input from experienced residents with specialized knowledge in specific areas. The main functions of the Advisory Committee

were to provide feedback on mitigation items suggested by the Technical Committee, and to help guide a plan for implementation and monitoring.

Project Advisory Committee

- Ken Duran, Assistant City Manger, City of San Dimas
- David Bratt, Planning Commission, City of San Dimas
- Neil Oudejans, Public Safety Commission, City of San Dimas
- Robert Anderson, Public Safety Commission, City of San Dimas
- Paul Rippins, City of San Dimas Historical Society
- Eileen Mullen, Bonita Unified School District
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Laura Nash, City of San Dimas Community at Large
- Scott Dilley, Chamber of Commerce, City of San Dimas

State and Federal Requirements for Mitigation Plans

The following are federal requirements for approval of a Natural Hazard Mitigation Plan:

- Open public involvement, with discussion of the process and requirements.
- The public must be afforded opportunities for involvement in identifying and assessing risk, drafting a plan, and involvement in approval stages of the plan.
- An opportunity for community cooperation, including local government agencies, the business community, educational institutions, and non-profit input.
- Incorporation of local documents, including the local General Plan, the Zoning Ordinance, the Building Codes, and other pertinent documents.

The following components must also be part of the planning process and are detailed in the following sections:

- Complete documentation of the planning process
- A detailed risk assessment on hazard exposures in the community
- A comprehensive mitigation strategy, which describes the goals & objectives, including proposed strategies, programs, actions to avoid long-term vulnerabilities
- A plan maintenance process, which describes the method and schedule of monitoring, evaluating, and updating the plan and integration of the All Hazard Mitigation Plan into other planning mechanisms
- Formal adoption by the City Council
- Plan Review by both State OES and FEMA

The City of San Dimas exceeded the minimum requirement of two public workshops for public participation, in addition to the inclusion of representatives on the planning committee. City Staff facilitated various public meetings to gather comments and ideas from citizens about mitigation

planning and priorities for mitigation plan goals. The Natural Hazard Mitigation Plan was routinely briefed at City Council meetings, where residents were invited to comment. In addition, residents were encouraged to provide insight on natural hazard concerns via a survey that was distributed throughout City Hall, Senior Center, public library, and other community buildings. The survey was also available online at the City's website http://www.cityofsandimas.com. The data gathered from these forums assisted in tailoring the mitigation action items to best suit the City's needs. The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make the City of San Dimas more disaster resilient.

The City of San Dimas staff examined existing mitigation plans from around the country, current FEMA hazard mitigation planning standards (386 series) and the State of California Natural Hazards Mitigation Plan Guidance. Local cities in the area also provided informative guidance and help through their own Hazard Mitigation Plans.

Other reference materials consisted of county and city mitigation plans, including:

- State of California Natural Hazard Mitigation Plan
- City of Duarte, CA Natural Hazard Mitigation Plan
- City of Cerritos, CA Natural Hazard Mitigation Plan
- City of Pomona, CA Natural Hazard Mitigation Plan
- County of Los Angeles, All Hazards Plan

City staff collected data and compiled research on five hazards: earthquakes, landslides, flooding, wildfires, and wind storms. Various research materials were obtained through state agencies including the OES and CDF. Research included historical local newspapers, census information, City Plans, and the knowledge of various City departments.

How is the Plan Used?

Each section of the mitigation plan provides information and resources to assist in understanding the City and the hazard-related issues facing citizens, businesses, and the environment. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The structure of the plan enables people to use a particular section that is of interest to them. It also allows the City government to review and update sections as new data becomes available. The ability to revise individual sections of the mitigation plan places less of a financial burden on the City budget. Decision-makers can allocate funding and resources to selected pieces in need of review, thereby avoiding a comprehensive update, which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to San Dimas.

The mitigation plan is organized in three volumes. Volume I contains an executive summary,

introduction, City profile, risk assessments, plan maintenance. Volume II contains the five natural hazard sections and Volume III includes the appendices. Each section of the plan is described below.

Volume I: Mitigation Action Plan

Executive Summary
The Action Plan provides an overview of the mitigation plan mission, goals, and action items. The included action items address multi-hazard issues, as well as hazard-specific activities that can be implemented to reduce risk and prevent loss from future natural hazard events.

Section 1: Introduction
This segment describes the background and purpose of developing the mitigation plan.

Section 2: Community Profile
This portion of the plan presents the history, geography, demographics, and socioeconomics of San Dimas. It also serves as a tool to provide an historical perspective of natural hazards.

Section 3: Risk Assessment
This section provides information on hazard identification, vulnerability, and risk associated with natural hazards.

Section 4: Multi-Hazard Goals and Action Items
This section provides information on the process used to develop goals and action items that cut across the five natural hazards addressed in the mitigation plan.

Section 5: Plan Maintenance
This section provides information on plan implementation, monitoring, and evaluation.

Volume II: Hazard Specific Information

Hazard-specific information on the five chronic hazards is incorporated into this plan. Chronic hazards occur with some regularity and may be predicted through historic evidence and scientific methods. The hazards addressed in the plan include:

- Section 6: Earthquakes
- Section 7: Landslides
- Section 8: Flooding
- Section 9: Wildfires
- Section 10: Windstorms

Each of the hazard-specific sections includes information on the history, causes and characteristics, assessment, goals and action items, and local, state, and national resources.

Catastrophic hazards do not occur with the frequency of chronic hazards, but can have devastating impacts on life, property, and the environment. Because of the geology and terrain in Southern California, earthquakes, landslides, flooding and wildfires also have the potential to be catastrophic as well as chronic hazards.

Volume III: Resources

Plan appendices are designed to provide users of the City of San Dimas Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the plan, and potential resources to support the implementation process.

Appendix A: Plan Resource Directory
The resource directory includes city, regional, state, and national resources and programs that may be of technical and/or financial assistance to the City during plan implementation.

Appendix B: Public Participation Process
This appendix includes specific information on the various public processes used during development of the plan.

Appendix C: Benefit Cost Analysis
This section includes FEMA's requirements for benefit cost analysis in hazard mitigation and approaches for conducting economic analysis of proposed mitigation activities.

Appendix D: List of Acronyms
This section provides a list of acronyms for city, regional, state, and federal agencies and organizations that may be referred to within the Natural Hazards Mitigation Plan.

Appendix E: Glossary
This section provides a glossary of terms used throughout the plan.

Appendix F: Risk Assessment Worksheets
The appendix provides the preliminary risk assessment calculations for City structures in each hazard area.

2 Community Profile

Why Plan for Natural Hazards in the City of San Dimas?

Natural hazards affect citizens, property, the environment, and the economy of the City of San Dimas. Earthquakes, landslides, flooding, wildfires, and windstorms have exposed residents and businesses to the financial and emotional costs of recovering after natural disasters. The risk associated with these hazards increases as more people move to areas affected by natural hazards.

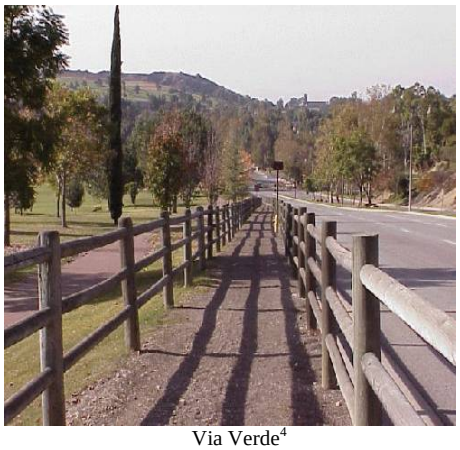
Even in those communities that are essentially built-out, like San Dimas, population density continues to increase when low density housing is replaced with medium and high density development projects.

The inevitability of natural hazards, and the growing population and activity within the City create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events. Identifying the risks posed by natural hazards, and developing strategies to reduce the impact of an event can assist in protecting life and property of citizens and communities. Local residents and businesses can work together with the City to create a natural hazards mitigation plan that addresses the potential impacts of hazard events.

Geography and the Environment

San Dimas has an area of 15.5 total square miles and is located in the eastern portion of the San Gabriel Mountains. Located in Los Angeles County, it is approximately 25 miles northeast of the City of Los Angeles. San Dimas is a foothill community and is bordered on the north by the San Gabriel Mountains. The western border is shared with the cities of Covina and Glendora. The City of La Verne is to the east and the cities of Pomona and Walnut make up the southern border.

The foothills in Spring[3]



Via Verde[4]

Elevations in the City range from 2,300-foot peaks at the foothills of the San Gabriel Mountains and the Angeles National Forest to a low of 940 feet in the southern border. The terrain of the City is characterized by a combination of flat and gently hilly topography.

The City of San Dimas has a rich history that originates in the nineteen century. The area comprising the City was settled in 1875 when its first school was constructed. The area was originally a part of a larger land grant of the Rancho San Jose, and San Dimas provided rich grassland for grazing and land for agriculture. On August 4, 19060, San Dimas was incoporated as a general law City.

The Foothill Freeway (Interstate 210) and Interstate 10, Orange Freeway 57, Corona Express Way 71, along with the California State Route 30 provide major access to the City. Rail service is provided by the Atchison, Topeka, and Santa Fe Railroads, and there are two railroad rights of way through the City. Metro Rail and the Southern Pacific Railroad carry both passengers and freight.

View of a San Dimas grove in 1900[5]

San Gabriel River

The nearest major river to San Dimas is the San Gabriel River. Because of its distance, the flow of the river does not have any great potential impact on the City; however, San Dimas may be affected indirectly, as part of the San Gabriel River Watershed. This watershed is bounded by the San Gabriel Mountains to the north, most of San Bernardino/Orange County to the east, the division of the Los Angeles River from the San Gabriel River to the west, and the Pacific Ocean to the south. The San Gabriel River runs from the San Gabriel Mountains to the Pacific Ocean.[6]

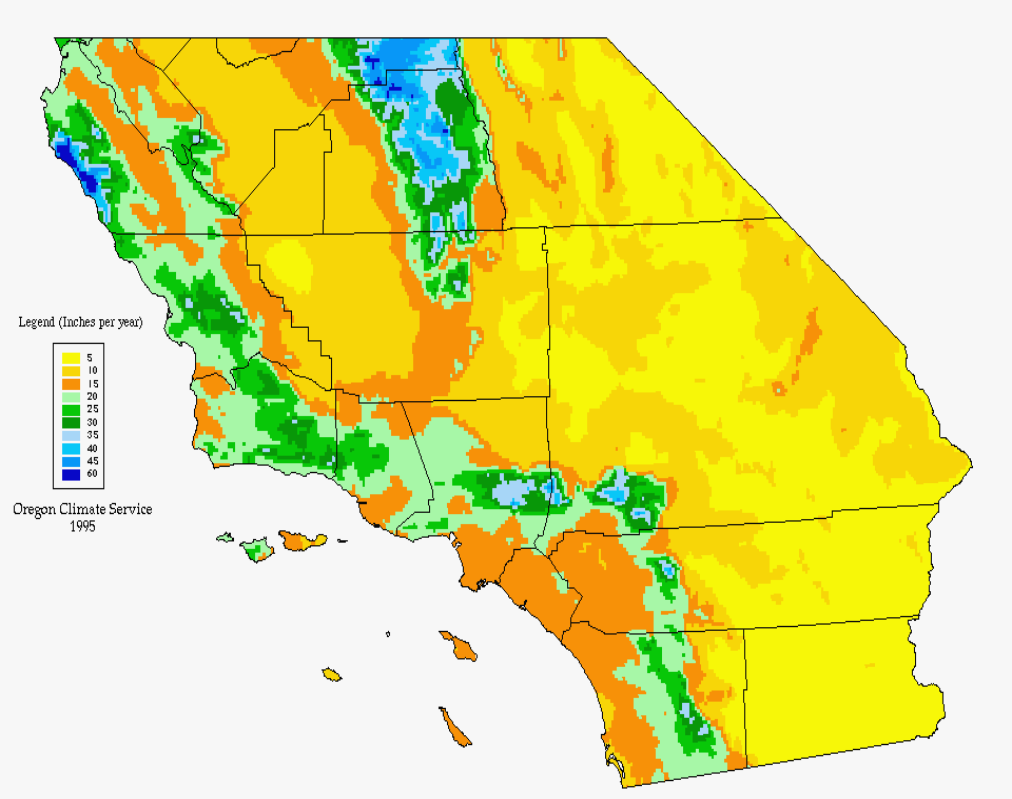
The River is 38 miles long within the basin flood plain, ten of which are entombed in concrete. The River was permanently altered in the 1930s in order to provide flood protection and irrigation. The Watershed is composed of approximately 640 square miles of land, with 26% of its total area developed. The major tributaries to the San Gabriel River include Walnut Creek, San Jose Creek, Coyote Creek, and numerous storm drains. The San Gabriel River is part of the County Flood Control District and Los Angeles County Public Works Department.[7]

Climate

The climate in San Dimas is Mediterranean or dry subtropical. Mean temperatures range from 48.8 degrees Fahrenheit in the winter months to 77.4 degrees Fahrenheit in the summer months. However, the temperatures can vary over a wide range, particularly when the Santa Ana winds blow, bringing higher temperatures and very low humidity. Temperatures sometimes exceed 100 degrees Fahrenheit in the summer months (June – September), and rarely drop below 30 degrees Fahrenheit in the winter months (November – March). Rainfall in the City averages 18.1 inches per year. In fact, San Dimas averages 5.1 more inches of rain than Los Angeles which because of its closer proximity to the San Gabriel Mountains.[8]

Actual rainfall in Southern California tends to accumulate in large amounts during sporadic and often heavy storms, rather than consistent, regular intervals. In short, rainfall in Southern California can be characterized as feast or famine within a single year. Because the metropolitan basin is largely built out, water originating in higher elevation communities can have a sudden impact on adjoining communities with lower elevations.

Map 2-1 Average Precipitation in Southern California



Minerals and Soils

The characteristics of the minerals and soils present in San Dimas indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether or not an area will be prone to geologic hazards such as earthquakes, liquefaction and landslides.

Mineral resources in the City of San Dimas have included mining for precious metal, soil, and gas. Mining for precious metal on a small scale primarily have taken place in the Angeles National Forest. Mining has been administered by the U.S. Forest Services. No permits are being issued for mining and no permits have been authorized for the last fifteen to thirty years. There are no significant major oil and gas fields within the City.

San Dimas began as an agricultural town.[9] Citrus orchards and row crops, such as strawberries were grown when it was first settled. The U.S. Soil Conservation Service has analyzed the soils in the San Dimas area into Land Capability Classification groups. These soil classifications are based on their ability to produce common cultivated crops and pasture pants without soil deterioration over an extended period of time. The broadcast category places all soils into eight classes arranged from I to VIII. There are no Class I (prime agricultural) soils in the City. There is Class II (potential prime agricultural) soils located in the northern half of the city. Understanding the geologic characteristics of San Dimas is an important step in hazard mitigation and avoiding at-risk development.[10]

Significant Geologic Features

San Dimas, like most of the Los Angeles Basin, lies over the area of one or more known earthquake faults, and potentially many more unknown faults, particularly so-called lateral or blind thrust faults. Major faults that have the potential to affect the greater Los Angeles Basin, and therefore the City of San Dimas are the San Andreas, the San Jacinto, Whittier-Elsinore, and Newport-Inglewood. These faults will be described in more detail in Section 6 of this Plan.

The Los Angeles Basin has a history of powerful and relatively frequent earthquakes, dating back to the powerful 8.0+ San Andreas earthquake of 1857 that did substantial damage to the relatively few buildings that existed at the time. Paleo-seismological research indicates that large (8.0+) earthquakes occur on the San Andreas fault at intervals between 45 and 332 years with an average interval of 140 years.[11] Other lesser faults have also caused very damaging earthquakes since 1857. Notable earthquakes include the Long Beach earthquake of 1933, the San Fernando Earthquake of 1971, the 1987 Whittier Earthquake and the 1994 Northridge earthquake.

In addition, many areas in the Los Angeles Basin have sandy soils that are subject to liquefaction. Many areas may have buildings destroyed or unusable due to this phenomenon. Liquefaction is a phenomenon involving the loss of shear strength of a soil. The shear strength loss results from the increase of poor water pressure caused by the rearrangement of soil particles induced by shaking or vibration. Liquefaction has been observed in many earthquakes, usually in soft, poorly graded granular materials (i.e., loose sands), with high water tables. This process usually occurs in the soil during or shortly after a large earthquake. In effect, the liquefaction soil strata behave as a heavy fluid. Buried tanks may float to the surface and objects above the liquefaction strata may sink. Pipelines passing through liquefaction materials typically sustain a relatively large number of breaks in an earthquake. San Dimas has liquefaction zones as shown on Map 2-2.

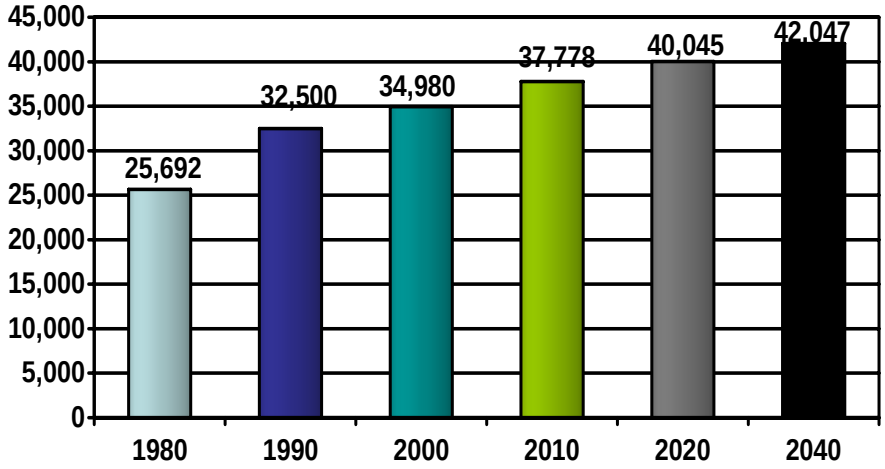
Soils most prone to liquefaction are medium to fine sand fractions located in areas where the

water table is high. Since these unfavorable conditions overlap in few areas of the community, the overall liquefaction potential is low. The areas are generally north of Way Hill, central-southwestern portion of the City, and in the flood plains of San Dimas Wash near the western-central part of the City.

Population and Demographics

According to the 2000 Census, San Dimas has a population of about 34,980 people. The population of the City has vastly increased from the mid 1800's through 2000, and increased 7% from 1990 to 2000. According to the US Census, growth is expected to continue, but at a decreasing rate.

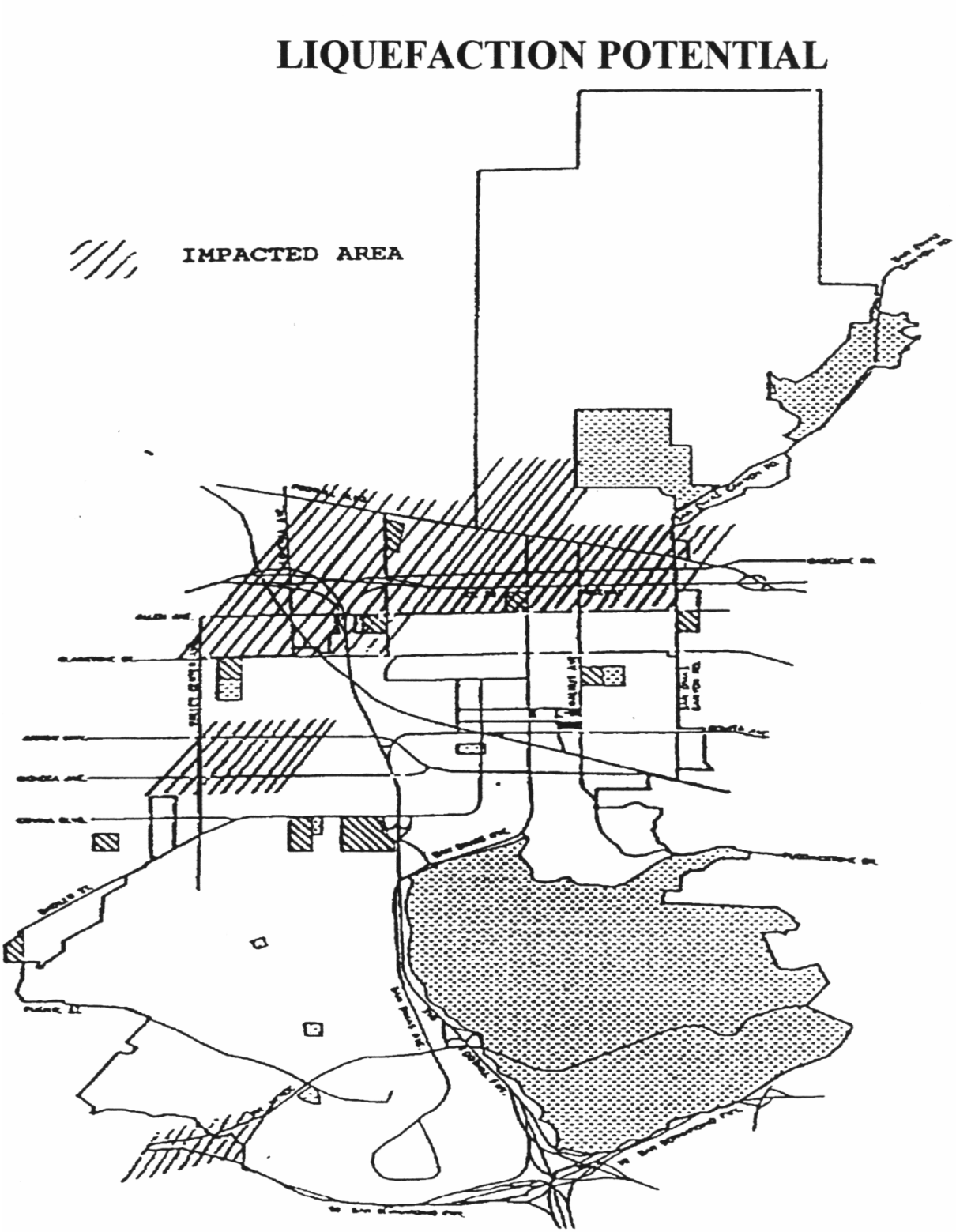
Figure 2-1 Historic and Projected Estimates of the Population in San Dimas



The increase of people living in the community creates more exposure to natural hazards, and forces change in how agencies prepare for and respond to natural hazards. For example, more people living on the urban fringe can increase risk of fire which has greater potential to injure people and cause property damage.

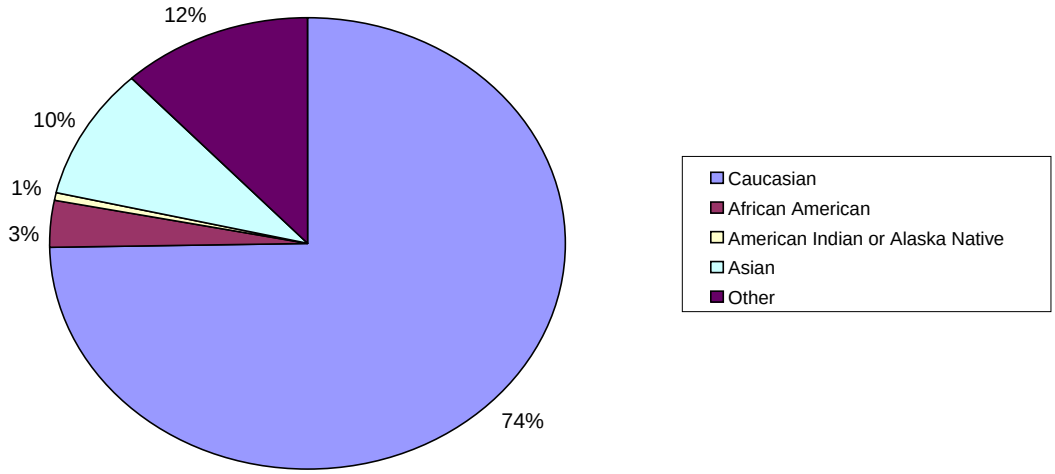
Increased density can also elevate risk. For example, narrower streets are more difficult for emergency service vehicles to navigate because the higher ratio of residents to emergency responders affects response times. Homes are located closer together because of the amplified density, which further increases the chance of fires spreading.

Map 2-2



Natural hazards do not discriminate, but the impacts in terms of vulnerability and the ability to recover vary greatly among the population. According FEMA, 80% of the disaster burden falls on the public, and within that number, a disproportionate burden is placed upon special needs groups: women, children, minorities, and the poor.[12] By observing the ethnic and cultural diversity in Figure 2-2, it is apparent that the City needs to address multi-cultural needs and services.[13]

Figure 2-2 Racial Breakdown of the City of San Dimas



The percentage of poverty in San Dimas is about 6.3%, which is less than .0004% of California's total. Of this population, 56.8% are under 18 years old, and 6.2% are over sixty-five. Vulnerable populations, including seniors, disabled citizens, women, and children, as well as those people living in poverty, tend to be disproportionately affected by natural hazards. Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural disasters identify special needs populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

The cost of natural hazards recovery can place an uneven financial responsibility on the general population while only a small proportion may benefit from the governmental funds used to rebuild private structures. Discussions about natural hazards that include local citizen groups, insurance companies, and other public and private sector organizations can help ensure that all stakeholders are a part of the decision-making processes.

Land and Development

From the early days of settlement, development in Southern California was a cycle of boom and bust. However, the Second World War dramatically changed that cycle. Military personnel and defense workers came to Southern California to fill the logistical needs created by the war effort. The available housing was rapidly exhausted and existing commercial centers proved inadequate for the influx of people.

Immediately after the war, construction began on the freeway system, and the face of Southern California was forever changed. Home developments and shopping centers seemed ubiquitous, and within a few decades, the central basin of Los Angeles County was essentially built-out. This continually pushed new development further away from the urban center. The City of San Dimas was one of a number of cities that incorporated during the boom of this 1950s and 1960s.

Because the environment of most Los Angeles County cities is nearly identical with that of their immediate neighbors, and the transition from one incorporated municipality to another is seamless to most people. Seamless too are the exposures to the natural hazards that affect all of Southern California.

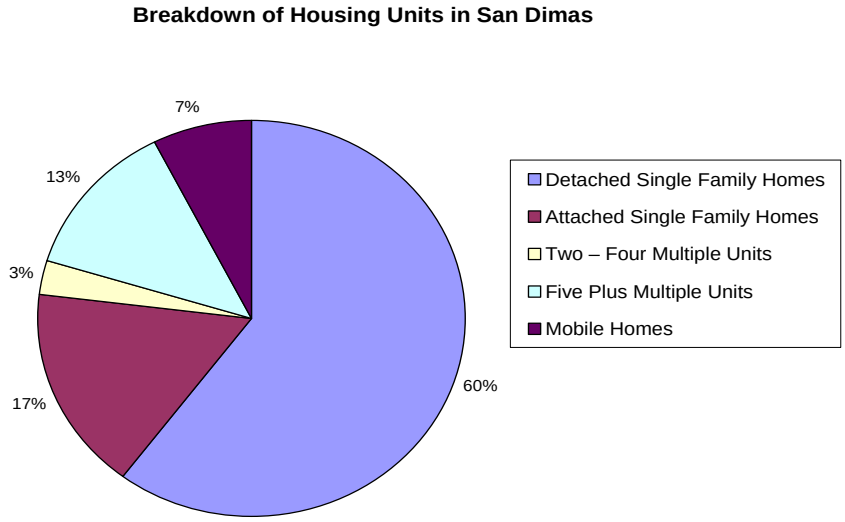
The San Dimas General Plan addresses the use and development of private land, including residential and commercial areas. This is one of the City's most important tools in addressing environmental challenges and development. It includes information transportation and air quality, growth management; conservation of natural resources; clean water and open spaces

Housing and Community Development

The high demand for housing in rural settings and smaller cities, coupled with the recent low interest rates, has led to a strong real estate market in the region. Substandard housing conditions may not be a serious problem citywide, but areas of San Dimas have been identified with a number of substandard dwelling units. There were nearly 2,000 very low and low-income households in the City in 1990 that spent more than 30 percent of gross household income on housing. According to the Southern California Association of Governments (SCAG), there is a projected need for 91 new housing units over the next five years.

As seen throughout the state, residential values have been steadily rising over the years. From 1991- 2001 home prices have gone up an average of 12% and continues to rise every year (2002 – 18 percent; 2003 – 19 percent; 2004 26.6 percent). Demand for low to medium priced homes continues to be strong. The average value for homes in the City of San Dimas is approximately $232,400.[14] The figure below demonstrates the breakdown of housing by type for the 12,672 housing units throughout the City.

Figure 2-3 Housing Breakdowns for the City of San Dimas[15]



Of the total units, 73.7% are owner occupied housing units, while 26.3% are renter occupied. There is a 1.0% homeowner vacancy rate and a 2.6% rental vacancy rate. [16]

To address development issues, the City has engaged in activities that promote the quality of life for the citizens of San Dimas. The large-scale effort is termed the City of San Dimas Housing Program, and includes neighborhood and other public facility improvements, rehabilitation of existing housing, and new housing development. Program activities must primarily benefit households or individuals who meet U.S. Department of Hosing and Urban Development (HUD) low and moderate-income limits. HUD provides funding for the program. Active federal programs include Community Development Block Grants (CDBG), Rehabilitation Loan Program, HOME Investment Partnership Program, and redevelopment housing set-aside funds. The primary resource available to address non-housing community development needs is the CDBG. The City's CDBG allocation for 2000 was $265,000.[17]

While there has been an increased concentration of resources and capital in San Dimas, the does not reflect how the income is distributed among residents of the area. The City's per capita personal income is increasing relative to California's and the United States' average per capita incomes, resulting in a more affluent community than the average population.

Subtle, but measurable changes occur constantly in communities that can increase the potential loss that will occur in a major disaster. There are number of factors contributing to this increasing loss potential. First, as populations continue to increase, more people are at risk within a region. Also, inflation continually increases the worth of real property and improvements. Finally, the amount of property owned per capita increases over time. The following figure demonstrates the dramatic changes in the US over the past thirty years.

Figure 2-4 Average Housing Standards Changes in the United States [18]

Amount of Property per person	1975	1998
Increased Size of new homes	1645 sq. ft.	2190 sq. ft.
% of homes with 4 + bedrooms	21%	33%
% of homes with 2 ½ or more baths	20%	52%

If we look at the greatest recorded earthquakes in American history, and compare the level of population and development today with that which existed at the time of the event, the scale of potential damage is staggering.[19] For examples, if the three worst earthquakes happened today, the results would be disastrous.

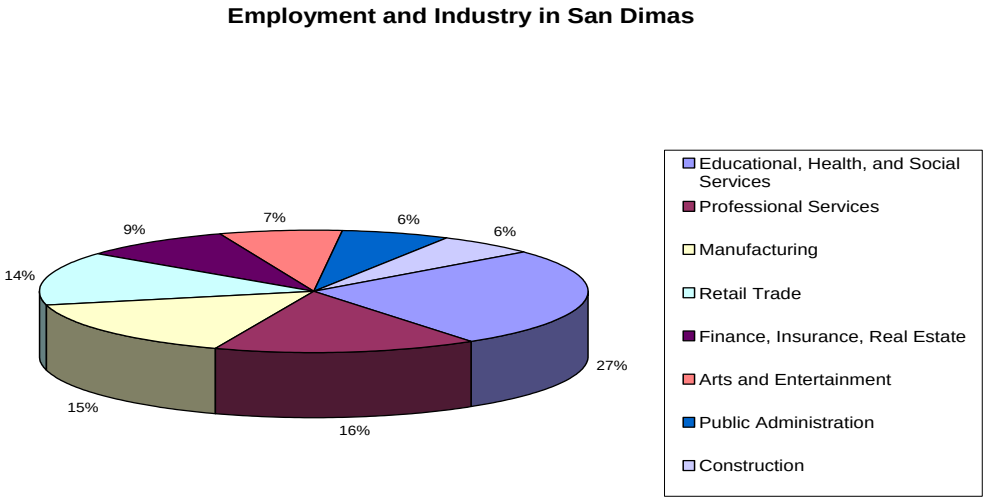
1886 Charleston, SC Earthquake M7.3
Estimated insured damage if happened today $10 Billion

1906 San Francisco Earthquake M8.3
Estimated insured damage if happened today $36 Billion

1811-12 New Madrid Earthquake Series (four earthquakes)
Estimated insured damage if happened today $88 Billion

Employment and Industry

In 2004, the City of San Dimas provided over 8997 jobs.[20] The principle industries and occupations are provided in Figure 2-5 below.



It is important to remember that mitigation activities are needed at the business level to ensure the safety and welfare of workers and limit damage to industrial infrastructure. Employees commute from surrounding areas to business centers. This mobility creates a greater dependency on roads, communications, accessibility, and emergency plans to ensure safety during a disaster. Before a natural hazard event, both large and small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Transportation and Commuting Patterns

The City of San Dimas is the 70th largest in the Los Angeles Metropolitan Statistical Area (LAMSA), and is continually growing. Since private automobiles are the dominant means of transportation in Southern California and San Dimas, this growth could potentially lead to larger problems. Keeping this in mind, the City meets its public transportation needs through a mixture of a regional transit system, MTA, and various localized bus systems. MTA provides both bus and light rail service to the entire LA County Metropolitan area. In addition to these services, the City promotes alternative transportation activities.

The City has developed an extensive system of multi-use trails. These are primarily used for recreation, but they offer an alternative transportation mode to get to work, school, and shop. The local bikeway system, including regional bike paths, provides a substitute method of transportation with several loops in the downtown area and connecting links each with the Via Verde and Frank G. Bonelli Regional Park, with additional trails being considered.[21]

Almost fifty five percent of San Dimas' population works outside of the City. This suggests that population growth is a more suburban phenomenon, where many residents live in San Dimas but work in other communities. However, a rapid growth rate in the high technology industry has attracted commuters to travel in the opposite direction as well, with more than one in three jobs filled by nonresidents.

San Dimas is served by the Foothill Freeway (Interstate 210), the Orange Freeway 57, Corona Express Way 71, the San Bernardino Freeway (Interstate 10), and California State Route 30, which connect the City to adjoining parts of Los Angeles County. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region, as well as local, regional, and national commercial traffic. For example, localized flooding can render roads unusable. A severe winter storm has the potential to disrupt the daily driving routine of hundreds of thousands of people. Natural hazards can disrupt automobile traffic and shut down local and regional transit systems.

The inevitability of natural hazards, coupled with the growing population and activity within the City create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events. Identifying the risks posed by natural hazards, and developing strategies to reduce the impact of an event can assist in protecting life and property of citizens and communities. These risks are addressed in the following section of the Natural Hazard Mitigation Plan.

3 Risk Assessment

What is a Risk Assessment?

Risk assessments can provide information on the probable location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. The following steps are detailed in each of the five hazard sections. Specifically, the levels of a risk assessment are as follows.

1) Hazard Identification
This section describes the geographic extent, potential intensity and the probability of occurrence of a given hazard. Maps are frequently used to display hazard identification data. The City of San Dimas identified five major hazards that affect this geographic area. These hazards, earthquakes, landslides, flooding, wildfires and windstorms, were identified through an extensive process that utilized input from the Hazard Mitigation Committees. The geographic extent of each of the identified hazards and are illustrated by the maps listed in Table 3-1.

2) Profiling Hazard Events
This profile describes the characteristics of each hazard, historical impacts on San Dimas, and vulnerable parts of the City's population, infrastructure, and environment. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard chapter.

3) Vulnerability Assessment/Inventorying Assets
This is a combination of hazard identification with an inventory of the existing (or planned) property developments and populations exposed to a hazard. Critical facilities are of particular concern because these entities provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the City and fulfill important public safety, emergency response, and disaster recovery functions. The critical facilities have been identified, mapped, and are illustrated in Map 3 at the end of this section. A description of the critical facilities in the City is also provided in this section. In addition, each hazard section includes a community issues summary to identify the most vulnerable areas in the City.

4) Risk Analysis
Estimating potential losses involves assessing the damage, injuries, and financial costs likely to be sustained in a geographic area over a given period of time. Two measurable components of risk analysis are magnitude of the harm that may result and the probability of harm. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets.

5) Assessing Vulnerability/ Analyzing Development Trends
This step provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use

decisions. This plan provides comprehensive description of the character of the City of San Dimas in the Community Profile. This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of San Dimas can help identify potential problems, and serve as a guide for incorporating goals contained in this mitigation plan into other community development areas.[22]

Table 3-1 List of Hazard Mitigation Plan Charts and Maps

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for an assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from City, County, or State agency sources.

Regardless of the data available for hazard assessments, there are numerous strategies the City can take to reduce risk. These strategies are described in the action items detailed in each hazard section of this Plan. Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items throughout the hazard sections provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment. This risk assessment requirement is intended to provide information that will help communities identify and prioritize mitigation activities that will reduce losses from the identified hazards. The Federal criteria for risk assessment and how the City of San Dimas Natural Hazard Mitigation Plan complied with those guidelines is outlined in Table 3-2 below.

Table 3-2 Federal Criteria for Risk Assessment

Section 322 Plan Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes an inventory of the best available data sources that identify hazard areas. The City utilized maps when identifying the location of the hazard in the City. The Executive Summary and the Risk Assessment sections of the plan include a list of the hazard maps.
Profiling Hazard Events	Each section includes documentation of the history, causes, and characteristics of each hazard in the City.
Assessing Vulnerability: Identifying Assets	Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses:	The Risk Assessment Section of this mitigation plan identifies key critical facilities and lifelines in the City and includes a map of these facilities. Vulnerability assessments

	have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available.
Assessing Vulnerability: Analyzing Development Trends	The City of San Dimas Profile Section of this plan provides a description of the development trends in the City, including the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Critical Facilities and Infrastructure

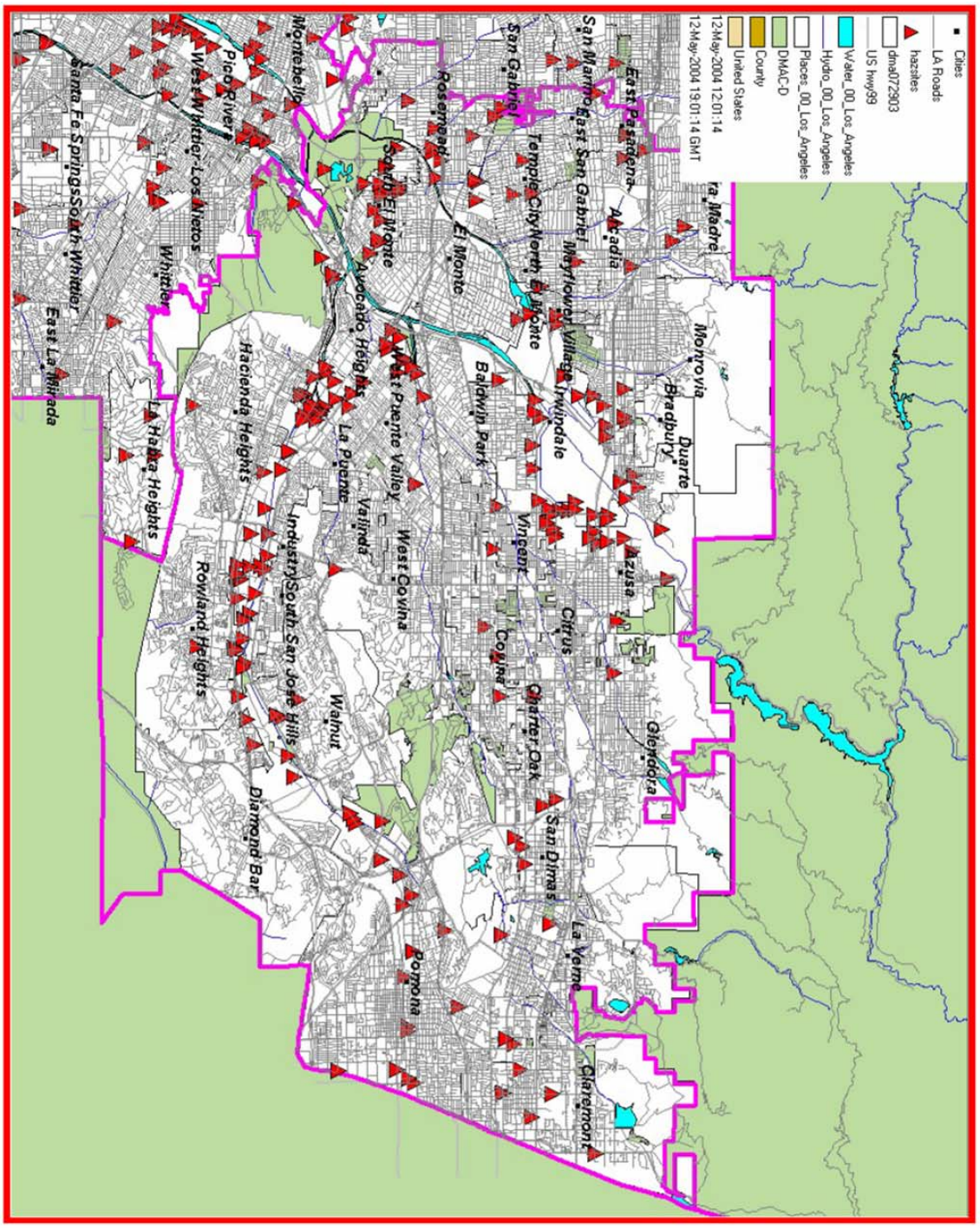
Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include: emergency operations centers, police and fire stations, public works facilities, communications centers, sewer and water facilities, hospitals, bridges and roads, shelters. Facilities that, if damaged, could cause serious secondary impacts may also be considered critical.

Critical and essential facilities are those facilities that are vital to the continued delivery of key government services or that may significantly affect the public's ability to recover from the emergency. These facilities may include jails, law enforcement centers, public services buildings, community corrections centers, courthouses, juvenile services building, and other public facilities such as schools. The charts and maps on the following pages illustrate the critical facilities, essential facilities, public infrastructure, and emergency transportation routes within the City of San Dimas

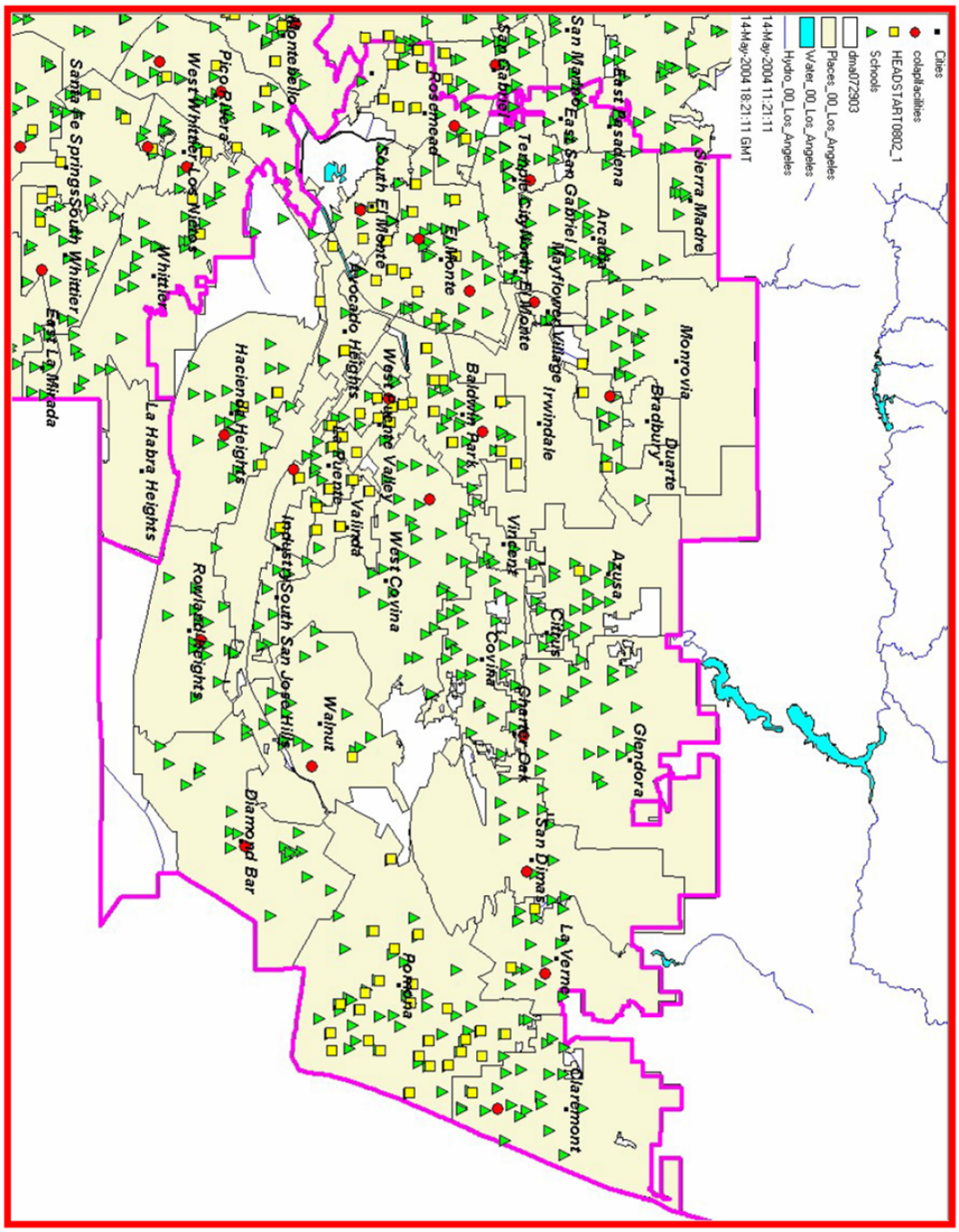
Summary

Natural hazard mitigation strategies reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Mitigation for industries and employers includes developing relationships with emergency management services and their employees before disaster strikes. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

Map 3-1 Critical Facilities



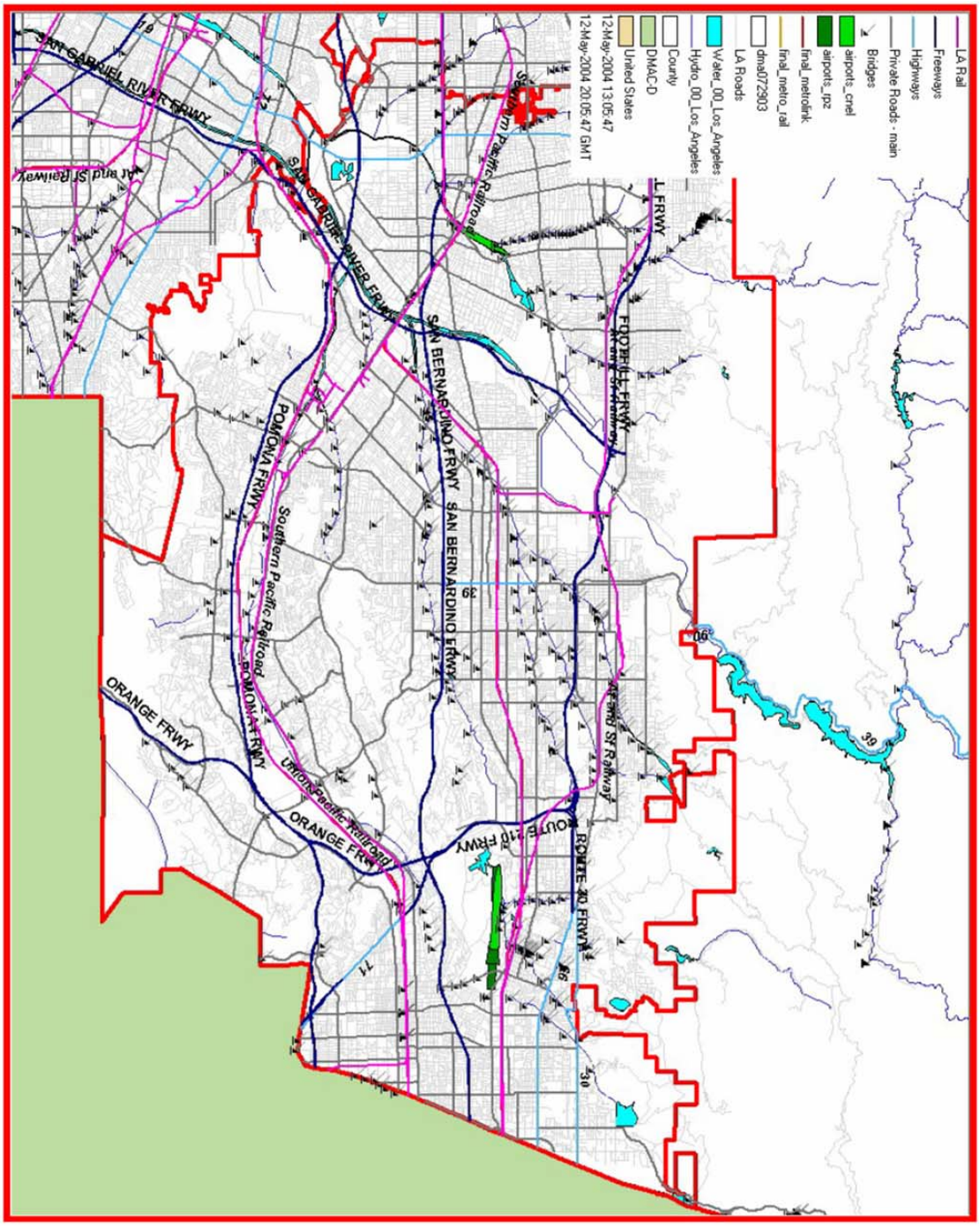
Map 3-2 Essential Facilities



SCHOOLS, HEAD STARTS, & LIBRARIES

This map depicts the location of Schools, Head Starts, & Libraries in Disaster Management Area D

Map 3-3 Infrastructure



4 Multi-Hazard Goals & Action Items

This section provides information on the process used to develop goals and action items that pertain to the five natural hazards addressed in the mitigation plan. It also contains the framework that focuses the plan on developing successful mitigation strategies. This section consists of three parts: the Mission, Goals, and Action Items.

Mission

The mission of the San Dimas NHMP is to establish and promote a comprehensive mitigation policy and program designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the City towards building a safer, more sustainable community.

Goals

The plan goals describe the overall direction that the City of San Dimas, organizations, and citizens can take to minimize the impacts of natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations that are outlined in the action items.

Action Items

The action items are a list of activities in which City agencies and citizens can be engaged to reduce risk. Each action item includes an estimated time line for implementation. Short-term action items are activities that City agencies may implement with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between one and five years (or more) to implement.

Mitigation Plan Goals and Public Participation

The Plan goals help to guide direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Protect Life and Property

- Identify natural hazards that threaten life and property in the City of San Dimas.
- Implement programs and projects that assist in protecting lives by making infrastructure, critical facilities, and other property more resistant to losses.
- Reduce losses and repetitive damages for chronic hazard events while promoting insurance coverage for catastrophic hazards.

- Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventive measures for existing development in areas vulnerable to natural hazards.

Public Awareness

- Increase public awareness of existing threats and the means to reduce these threats by conducting educational and outreach programs to all the various community groups in the City.
- Provide informational items, partnership opportunities, and funding resource information to assist in implementing mitigation activities.

Partnerships and Implementation

- Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in the implementation of mitigation measures.
- Encourage and support leadership within the private sector, non-profit agencies and community-based organizations to promote and implement local hazard mitigation activities.

Emergency Services

- Establish policy to ensure the importance of mitigation programs and projects for critical facilities, services, and infrastructure.
- Continue providing emergency services with training and equipment to address all identified hazards.
- Continue developing and strengthening inter-jurisdictional coordination and cooperation in the area of emergency services.

Environmental & Historical Preservation

- Balance land use planning with natural and manmade hazard mitigation to protect life, property and the environment.

Public Participation

The City of San Dimas staff facilitated various public forums to gather comments and ideas from citizens about mitigation planning and priorities for mitigation plan goals. The Natural Hazard Mitigation Plan was routinely briefed at City Council meetings, where attendees were invited to comment. In addition, residents were encouraged to provide insight on natural hazard concerns via a survey that was distributed throughout City Hall, Senior Center, public library, and other community buildings. The survey was also available online at the City's website http://www.cityofsandimas.com. The data gathered from these forums was used to tailor the

mitigation action items to best suit the City's needs. The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make the City of San Dimas more disaster resilient.

Natural Hazard Mitigation Plan Action Items

The mitigation plan identifies short and long-term action items developed through data collection and research, and the public participation process. Mitigation plan activities may be considered for funding through Federal and State grant programs, and when additional funds are made available through the City. Action items address multi-hazard (MH) and hazard specific issues. To help ensure activity implementation, each action item includes information on the time line and coordinating organizations. Upon implementation, the coordinating organizations may look to partner organizations for resources and technical assistance. A description of the partner organizations is provided in Appendix A, the resource directory of this plan.

Coordinating Organization
The coordinating organization is the organization that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Coordinating organizations may include local, city, or regional agencies that are capable of or responsible for implementing activities and programs.

Time line
Action items include both short and long-term activities. Each action item includes an estimate of the time line for implementation. Short-term action items are activities that city agencies may' implement with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between two and five years (or more) to implement.

Ideas for Implementation
Each action item includes ideas for implementation and potential resources, which may include grant programs or human resources.

Plan Goals Addressed
The plan goals addressed by each action item are included as a way to monitor and evaluate how well the mitigation plan is achieving its goals once implementation begins.

Constraints
Constraints may apply to some of the action items. These constraints may be a lack of city staff, lack of funds, or vested property rights which might expose the City to legal action as a result of adverse impacts on private property.

Cost-Benefit Analysis
Each jurisdiction will have some limitations on the number and cost of mitigation activities that can be completed within a given period of time. There are likely to be multiple ideas to mitigate

the effects of a given hazard. Therefore, it will be necessary for the committee to select the most cost effective mitigation projects and to further prioritize them. Information in Appendix C guides the City on how to conduct and exercise a cost benefit analysis.

Multi-Hazard Action Items

Multi-hazard action items are those activities that pertain to two or more of the five hazards in the mitigation plan: flood, landslide, wildfire, windstorm, and earthquake.

Action Item 6.1: Enhance data and mapping information within the City and identify and map hazard prone areas.
Implementation Initiatives:

> *Implementation Initiative 6.1.1* Develop a complete GIS system and provide training to all pertinent personnel.

Coordinating Organizations: City Administration Department
Time line: Short-term.
Plan Goals Addressed: Protect life and property.

Action Item 6.2: Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.
Implementation Initiatives:

> *Implementation Initiative 6.2.1* Educate the public about emergency sheltering and evacuation procedures.
>
> *Implementation Initiative 6.2.2* Collaborate with the Bonita Unified School District on educational natural hazard awareness programs.
>
> *Implementation Initiative 6.2.3* Place public information brochures related to mitigating natural hazards at the Senior Center, Teen Center, Library, and City Hall.

Coordinating Organizations: City Administration Department
Time line: Ongoing.
Plan Goals Addressed: Increase public awareness.

Action Item 6.3: Enhance and expand the City's emergency response capabilities.
Implementation Initiatives:

> *Implementation Initiative 6.3.1* Develop and offer a CERT programs to residents.

Implementation Initiative 6.3.2 Augment training of Emergency Response Teams.

Implementation Initiative 6.3.3 Develop an employee communication response plan.

Implementation Initiative 6.3.4 Consider the feasibility of appointing a dedicated Emergency Preparedness Coordinator.

Coordinating Organizations: City Administration Department, Los Angeles County Sheriff's Department
Time line: Short-term, Ongoing.
Plan Goals Addressed: Strengthen City Emergency Services.

Action Item 6.4: Integrate the goals and action items from the City of San Dimas' Natural Hazard Mitigation Plan into existing regulatory documents and programs where appropriate.
Implementation Initiatives:

Implementation Initiative 6.4.1 Consider incorporating mitigation goals and action items into the Safety Element of the City of San Dimas General Plan when the General Plan is next updated.

Implementation Initiative 6.4.2 Continue to change the City Building Code, where appropriate, to reflect future changes to the California Building Code.

Coordinating Organizations: City Planning Department, City Building and Safety Division
Time line: Long-term, Ongoing.
Plan Goals Addressed: Strengthen partnerships.

Action Item 6.5: Identify and pursue funding opportunities to develop and implement local mitigation activities.
Implementation Initiatives:

Implementation Initiative 6.5.1 Monitor the State Hazard Mitigation Office at the California Office of Emergency Services for information on hazard mitigation funding.

Implementation Initiative 6.5.2 Monitor the Federal Emergency Management Agency for grant programs to implement mitigation goals.

Implementation Initiative 6.5.3 Identify organizations and agencies that may support mitigation activities.

Coordinating Organizations: City Administration Department

Time line: Ongoing.
Plan Goals Addressed: Strengthen partnerships.

Action Item 6.6: Develop a warning system to alert residents of potential hazards as well as provide post-disaster information.
Implementation Initiatives:

> *Implementation Initiative 6.6.1* Evaluate the feasibility of a communication system to send out a blanket call to residents warning them of potential hazards.

Coordinating Organizations: City Administration Department
Time line: Long-term.
Plan Goals Addressed: Increase public awareness.

5 Plan Maintenance

The maintenance section of this document details the formal process that will ensure that the City NHMP remains an active and relevant document. The process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan maintenance process. Finally, it includes an explanation of how San Dimas intends to incorporate the mitigation strategies outlined in this plan into existing planning mechanisms such as the City General Plan, Capital Improvement Plans, and Building and Safety Codes.

Monitoring and Implementing the Plan

Plan Adoption

City Council will be responsible for adopting San Dimas NHMP because they have the authority to promote sound public policy regarding natural hazards. Once the plan has been adopted, the Assistant City Manager will be responsible for submitting it to the State Hazard Mitigation Officer at The Governor's Office of Emergency Services. The Governor's Office of Emergency Services will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. Upon acceptance by FEMA, the City of San Dimas will gain eligibility for Hazard Mitigation Grant Program funds.

Coordinating Body

Two Hazard Mitigation Committees will be responsible for coordinating implementation of plan action items and undertaking the formal review process. City Council will assign representatives from city agencies, including, but not limited to, the current Hazard Mitigation Advisory and Technical Committee members. The City has formed a Hazard Mitigation Advisory Committee that consists of members from local agencies, organizations, and citizens. This Committee, which will meet semi-annually, consists of representatives from the following divisions:

- City of San Dimas Administrative Services
- City of San Dimas Building and Safety Division
- City of San Dimas Community Development
- City of San Dimas Planning Commission
- City of San Dimas Public Safety Commission
- City of San Dimas Chamber of Commerce
- City of San Dimas Historical Society
- The Los Angeles County, San Dimas Sheriff's Department
- The Los Angeles County, San Dimas Fire Department

The Hazard Mitigation Technical Committee will meet no less than quarterly. These meetings will provide an opportunity to discuss the progress of the action items and maintain the

partnerships that are essential for the sustainability of the mitigation plan. This Committee will be responsible for the updates and revisions of the NHMP. The Technical Committee will consist of the representatives from the following divisions:

- County of Los Angeles Fire Department
- County of LA Sheriff's Department
- Department of Building and Safety, City of San Dimas
- Department of Administration, City of San Dimas

Convener

City Council will adopt the San Dimas NHMP, and the Hazard Mitigation Advisory Committee will take responsibility for plan implementation. The Assistant City Manager will serve as a convener to facilitate the Hazard Mitigation Advisory Committee meetings, and will assign tasks such as updating and presenting the Plan to the members of the committee. Plan implementation and evaluation will be a shared responsibility among all Committees.

Implementation through Existing Programs

San Dimas addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans, and City Building and Safety Codes. The Natural Hazard Mitigation Plan provides a series of recommendations - many of which are closely related to the goals and objectives of existing planning programs. The City of San Dimas will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

The City of San Dimas Building & Safety Department is responsible for administering the Building & Safety Codes. In addition, the Hazard Advisory Committee will work with other agencies at the state level to review, develop and ensure Building & Safety Codes that are adequate to mitigate or present damage by natural hazards. This is to ensure that life-safety criteria are met for new construction.

The goals and action items in the mitigation plan may be achieved through activities recommended in the city's Capital Improvement Plans (CIP). Various city departments develop CIP plans, and review them on an annual basis. Upon annual review of the CIP, the Hazard Mitigation Technical Committee will work with the City departments to identify areas that the hazard mitigation plan action items are consistent with CIP planning goals and integrate them where appropriate.

Within six months of formal adoption of the mitigation plan, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the city level. The meetings of both the Hazard Mitigation Advisory and Technical Committees will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into city planning documents and procedures.

While the City of San Dimas does not have a particular funding source for the implementation of the NHMP, money is available through the General Fund. In addition, the City will actively seek competitive grants through organizations such as FEMA and the State of California.

Evaluating and Updating the Plan

Formal Review Process

The City of San Dimas Natural Hazards Mitigation Plan will be evaluated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The following process gives an approximate schedule and time line for evaluation and implementation of the plan, but allows the flexibility for change. The convener will be responsible for contacting the Hazard Mitigation Advisory Committee members and organizing the annual meeting. Both Advisory and Technical Committees will be responsible for monitoring and evaluating the progress of the Plan.

In their quarterly meetings, the Technical Committee will review goals and action items to determine their relevance to changing situations in the City, as well as changes in State or Federal policy, and to ensure they are addressing current and expected conditions. It will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. Further, the Technical Committee will be responsible to assess the changing nature and the magnitude of the five natural hazards profiled in this plan.

This Committee will also be responsible for the written revisions of the Natural Hazard Mitigation Plan each year. The designated committee members will have approximately three months to make appropriate changes to the Plan before submitting it to the Hazard Committees, and presenting it to the City Council. The Hazard Mitigation Advisory Committee will also notify all holders of the City plan when changes have been made. The updated plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review every five years.

The coordinating organizations responsible for each of their appropriated action items will provide annual reports to the Technical Committee on the status of their projects, coordination efforts, and the success of various implementation processes, technical, political, and legal difficulties encountered. The evaluation and implementation process is outlined in Table 5-1 at the end of this section.

Economic Analysis of Mitigation Projects

FEMA's approaches to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity can assist

communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later.

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Given federal funding, the Hazard Mitigation Advisory Committee will use a FEMA-approved benefit-cost analysis approach for high cost mitigation projects. For other projects and funding sources, the Hazard Mitigation Technical Committee will use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, please see Appendix C of the Plan.

Continued Public Involvement

The City of San Dimas is dedicated to involving the public directly in review and updates of the Hazard Mitigation Plan. The Hazard Mitigation Committees are responsible for the annual review and update of the plan.

The public will also have the opportunity to provide feedback about the Plan. Copies of the Plan will be catalogued and kept at all of the appropriate agencies in the city. The existence and location of these copies will be publicized in the quarterly city newsletter, *The Frontier*, which reaches every household in the City. The plan also includes the address and the phone number of the City Administration Department responsible for keeping track of public comments on the Plan. In addition, copies of the plan and any proposed changes will be posted on the city website with contact information to which people can direct their comments and concerns.

A public hearing will also be held after each annual evaluation or when deemed necessary by the Hazard Mitigation Advisory Committee. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the Plan. The City Public Information Officer will be responsible for using city resources to publicize the annual public meetings and maintain public involvement through the public access channel, web page, and newspapers.

Plan maintenance and monitoring is a vital process in ensuring the success of the NHMP. All of these components are necessary to incorporate the proper feedback into the Plan and to guarantee compliance and effectiveness.

Task	Years of Completion				
	2005	2006	2007	2008	2009
Incorporate NHMP into existing planning documents					
Encourage public feedback by posting NHMP on City Website					
Identify and seek grant programs and foundationas that support mitigation activities					
Continue practice of current hazard mitigation action items					
Evaluate implemented hazard mitigation action items					
Begin implementation of less expensive, short-term action items					
Quarterly meetings of Technical Committee					
Semi-annual meetings of Advisory Committee					
Yearly progress reports from all coordinating agencies for action items					
Conduct cost-benefit analysis of complex, long-term action items					
Public hearings to discuss Plan revisions					
Update NHMP with current data, maps, charts, and statistics					
Submit revised NHMP to FEMA and OES					

[1] Picture courtesy of **www.eastshorervpark.com/ about.htm**

[2] City of San Dimas Public Works Department. Picture courtesy of **www.wrightwoodcalif.com/ williamsgallery.html**. Taken September 23, 2002 by Royce Hutain.

[3] http://www.unet.univie.ac.at/~a7602464/galerie4/gal4foto/CN01-006-12-9604_72-480.jpg

[4] http://www.cityofsandimas.com

[5] **www.colapublib.org/ history/sandimas/images.html**

[6] *The River Project.* http://theriverproject.org

[7] *The Wetlands Recovery Project – LA County Gaps Report*

[8] <http://www.city-data.com/city/San-Dimas-California.html>

[9] picture courtesy of th4e San Dimas Historical Society

[10] San Dimas Chamber of Commerce

[11] Southern California Earthquake Center. << http://www.scec.org>>

[12] Peggy Stahl, Federal Emergency Management Agency (FEMA) Preparedness, Training, and Exercise Directorate <http://www.fema.gov>

[13] The United States Census Bureau. <http://www.census.gov>

[14] 2000 Census.

[15] Ibid.

[16] The raw data for the breakdown is as follows:

Detached Single Family Homes	7,654
Attached Single Family Homes	2,100
Two – Four Multiple Units	357
Five Plus Multiple Units	1,618
Mobile Homes	943
Total	12,672

[17] Community Development Commission of the County of Los Angeles. *2003 – 2008 Consolidated Plan; One Year Action Plan for 2004-2005.*

[18] United States Census Bureau.

[19] *Risk Management Solutions.*

[20] The United States Census Bureau. <http://www.census.gov>

[21] City of San Dimas. *General Plan.*

[22] Note: The City of San Dimas cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products. Although information from land surveys may have been used in the creation of these products, in no way does this product represent or constitute a land survey. Users are cautioned to field verify information on this product before making any decisions.

6 Why Are Earthquakes a Threat to the City of San Dimas?

The most recent significant earthquake event affecting the City of San Dimas and Southern California was the January 1994 Northridge Earthquake. At 4:31 A.M. on Monday, January 17, a moderate but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures.[1]

Fifty-seven people were killed and more than 1,500 people seriously injured throughout Southern California. For days afterward, thousands of homes and businesses were without electricity, tens of thousands had no gas, and nearly 50,000 had little or no water. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. Over 66,500 buildings were inspected, with nearly 4,000 severely damaged and over 11,000 moderately damaged structures. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Extensive damage was caused by ground shaking, but earthquake triggered liquefaction and dozens of fires also caused additional severe destruction. This extremely strong ground motion in large portions of Los Angeles County resulted in record economic losses.

Luckily, the earthquake occurred early in the morning on a holiday, considerably reducing the potential effects. Many collapsed buildings were unoccupied, and businesses were not yet open. However, the direct and indirect economic impacts still resulted in billions of dollars of losses.

San Dimas was not isolated from this quake. Fortunately, the City only experienced $50,000 in losses. The City had been hit much harder in the Sierra Madre earthquake in 1991, where there was over $40 million in damages throughout the San Gabriel Valley.

Historical and geological records show that California has a long history of seismic events. The best known fault in Southern California is the San Andreas Fault, a 400-mile long fault running from the Mexican border to a point off the coast of San Francisco. Geologic studies show that over the past 1,500 years large, earthquakes have occurred at about 130 year intervals on the southern San Andreas Fault. Since the last large earthquake on the Southern border of this fault occurred in 1857, this is a potential location for a major earthquake within the next few decades.[2]

However, the San Andreas is only one of dozens of known earthquake faults that cross the region. Some of the other known faults include the Newport-Inglewood, Whittier, Chatsworth, Elsinore, Hollywood, Los Alamitos, and Palos Verdes faults. There is also a potentially large number of blind faults that underlie the surface of Southern California. One such fault was involved in the Whittier Narrows earthquake in October 1987.

While the San Andreas is capable of producing an earthquake with a magnitude of 8+ on the Richter scale, some of the lesser faults have the potential to inflict greater damage on the urban core of the Los Angeles Basin. Seismologists believe that a 6.0 earthquake on the Newport-Inglewood would result in far more death and destruction than a great quake on the San Andreas, since most of the San Andreas is relatively remote from the urban centers of the region.[3]

For decades, partnerships have flourished between the USGS, USC, Cal Tech, the California Geological Survey and other universities to share research and educational efforts with Californians. Tremendous earthquake mapping and mitigation efforts have been made in California in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, local government agencies, and private organizations support earthquake risk reduction, and have made significant contributions in reducing the adverse impacts of earthquakes. Despite the progress, the majority of California communities remain unprepared because there is a general lack of understanding regarding earthquake hazards.

History of Earthquake Events in Southern California

Since seismologists started using instrumentation, there have been tens of thousands of recorded earthquakes in Southern California, most with a magnitude below three. Because of this, no community in Southern California is beyond the reach of a damaging earthquake. Table 6-1 describes the historical earthquake events that have affected Southern California.

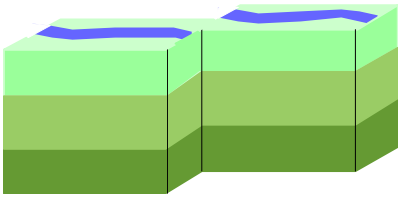
Table 6-1 Earthquake Events in the Southern California Region[4]

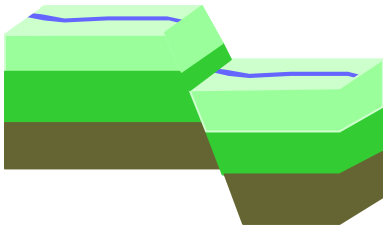
Southern California Region Earthquakes with a Magnitude 5.0 or Greater			
1769	Los Angeles Basin	**1916**	Tejon Pass Region
1800	San Diego Region	**1918**	San Jacinto
1812	Wrightwood	**1923**	San Bernardino Region
1812	Santa Barbara Channel	**1925**	Santa Barbara
1827	Los Angeles Region	**1933**	Long Beach
1855	Los Angeles Region	**1941**	Carpenteria
1857	Great Fort Tejon Earthquake	**1952**	Kern County
1858	San Bernardino Region	**1954**	Wheeler Ridge
1862	San Diego Region	**1971**	San Fernando
1892	San Jacinto or Elsinore Fault	**1973**	Point Mugu
1893	Pico Canyon	**1986**	North Palm Springs
1894	Lytle Creek Region	**1987**	Whittier Narrows
1894	San Diego	**1992**	Landers
1899	Lytle Creek Region	**1992**	Big Bear
1899	San Jacinto and Hemet	**1994**	Northridge
1907	San Bernardino Region	**1999**	Hector Mine

To fully understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on those faults that are the sources of the earthquakes occurring in the Southern California region. Historical earthquake records can generally be divided into records of the pre- and post-instrumental periods. In the absence of instrumentation, the detection of earthquakes was based on observations and felt reports, and dependent upon population density and distribution. Since California was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is relatively difficult. However, two very large earthquakes, the Fort Tejon in 1857 (7.9) and the Owens Valley in 1872 (7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. More recently, two 7.3 earthquakes struck Southern California, in Kern County (1952) and Landers (1992). Luckily, the damage from these four large earthquakes was limited because the occurred in areas which were sparsely populated at the time they happened. The seismic risk is much more severe today than in the past because the population at risk is in the millions, rather than the much less densely populated Southern California in the 19th century.[5]

Causes and Characteristics of Earthquakes in Southern California

A fault is a fracture along between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.



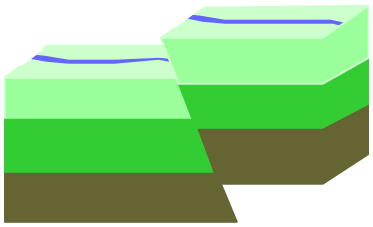


Strike-slip

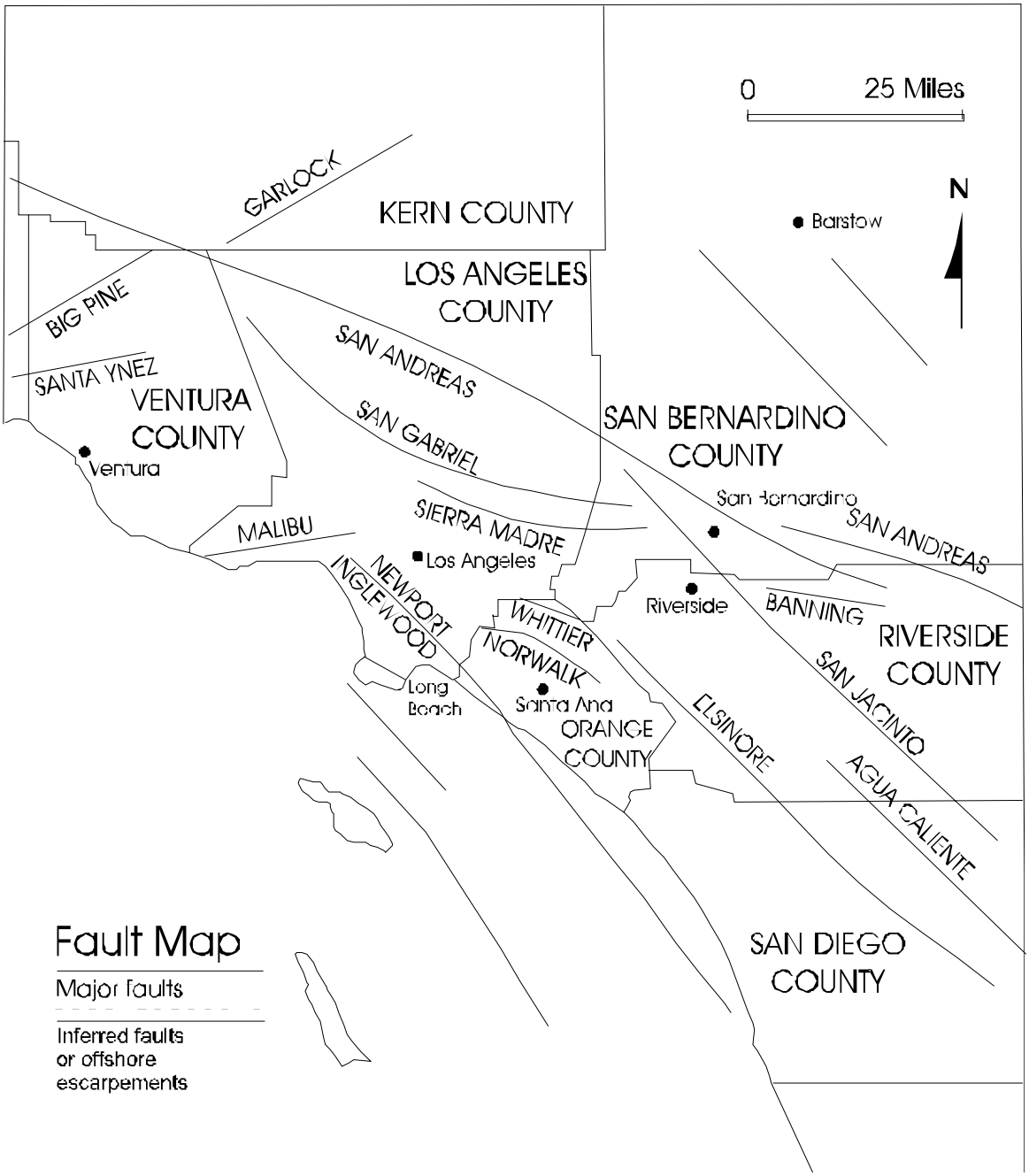
Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the shift is called a left lateral fault.

Dip-slip

Dip-slip faults are slanted fractures where the blocks mostly shift vertically. If the earth above an inclined fault moves down, the fault is called a normal fault, but when the rock above the fault moves up, the fault is called a reverse fault. Thrust faults have a reverse fault with a dip of 45 ° or less.



Map 6-1: Major Faults in Southern California



The record at Pallett Creek shows that a rupture has recurred approximately every 130 years, over the past 1500 years. But actual intervals have varied greatly, from less than fifty years to more than three hundred. The physical cause of such irregular recurrence remains unknown.[6] Damage from a great quake on the San Andreas would be widespread throughout Southern California.

Earthquake Related Hazards

Ground shaking, landslides, liquefaction, and amplification are the specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and the type of earthquake.

Ground Shaking

Ground shaking, the primary cause of earthquake damage, is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Earthquake Induced Landslides

Earthquake induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in Southern California have a high likelihood of encountering such risks, especially in areas with steep slopes.

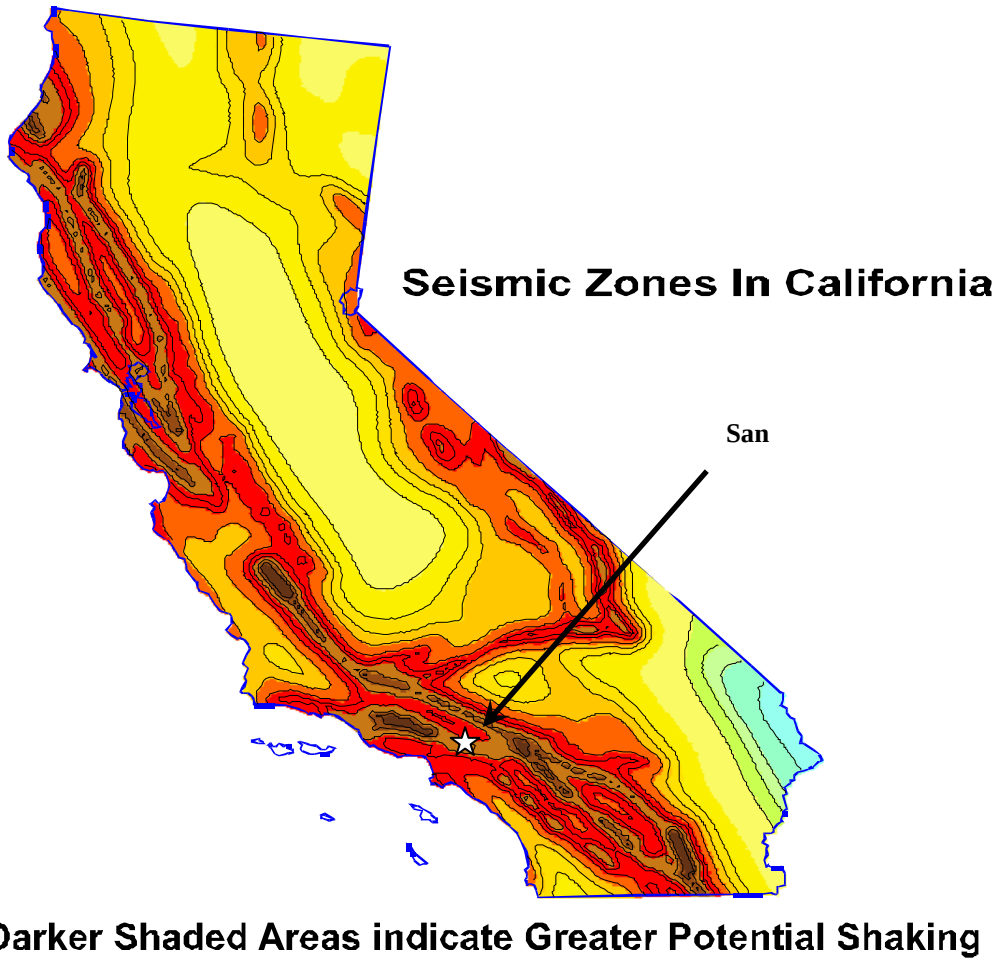
Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in a loss of soil strength and the ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these structures. Many communities in Southern California are built on ancient river bottoms and may be subject to the dangers of liquefaction. While liquefaction is not a grave problem in San Dimas, there still exists a potential of damage from it. Map 6-4 illustrates the liquefaction zones in the City.

Amplification

Amplification increases the magnitude of the seismic waves generated by the earthquake. Soils and soft sedimentary rocks near the earth's surface can modify this effect because the amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.[7] This problem can also occur in areas with deep sediment filled basins and on ridge tops.

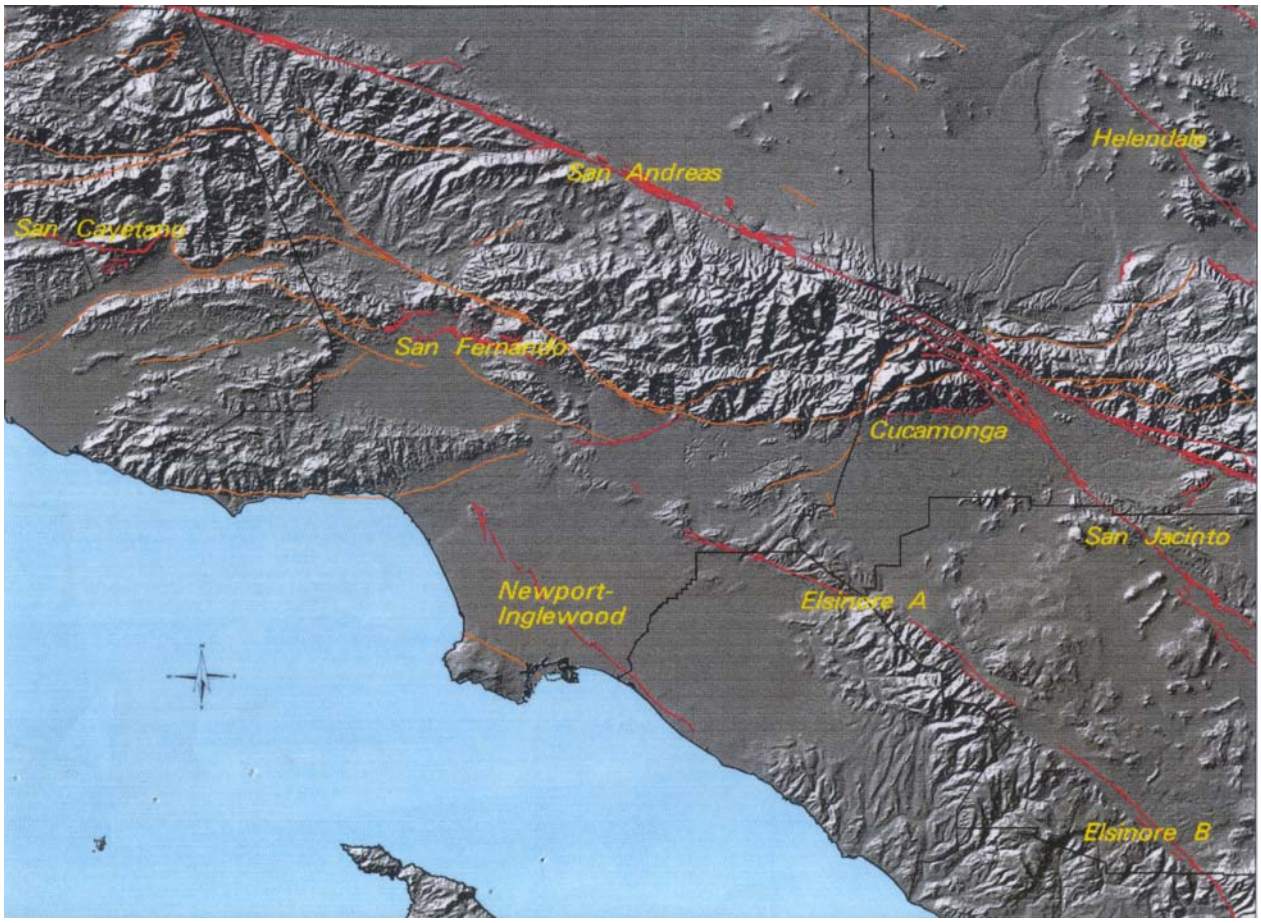
Figure 6-1: Seismic Zones in California[8]



Earthquake Hazard Assessment

Hazard Identification

In California, there are many agencies that focus on the importance of seismic safety issues. Institutions such as the State's Seismic Safety Commission, the Applied Technology Council, Governor's Office of Emergency Services, United States Geological Survey, Cal Tech, the California Geological Survey as well as a number of universities and private foundations, have undertaken a rigorous program in California to identify seismic hazards. These risks include active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in California through the State Division of Mines and Geology. Map 6-2 below shows localized faults in the area.



Map 6-2 Localized Faults

Major Faults Affecting the City of San Dimas

As evident by the above map, there are numerous faults in Southern California that have the potential to affect the City of San Dimas in the event of an earthquake. These faults are outlined in more detail below.

Clamshell – Sawpit Canyon Fault[9]

Nearest Communities: Sierra Madre, Monrovia

Most Recent Rupture: Late Quaternary (The Sierra Madre earthquake of 1991 probably originated on this fault. Though a sizeable earthquake, the depth of this quake prevented the rupture from reaching the surface.)

Cucamonga Fault Zone[10]

Nearest Communities: Claremont, Upland, Cucamonga

Most Recent Surface Rupture: Holocene

Interval between Major Ruptures: roughly 600 – 700 years

Probable Magnitudes: M6.0 – 7.0

Newport-Inglewood Fault[11]

Nearest Communities: Culver City, Inglewood, Gardena, Compton, Signal Hill, Long Beach, Seal Beach, Huntington Beach, Newport Beach, Costa Mesa
Most Recent Major Surface Rupture: March 10, 1933, M6.4 (but no surface rupture)
Interval between Major Ruptures: unknown
Probable Magnitudes: M6.0 - 7.4 This represents a worst-case earthquake that could affect the urban areas of Central and South Eastern Los Angeles County.

Palos Verdes Fault Zone[12]

Nearest Communities: San Pedro, Palos Verdes Estates, Torrance, Redondo Beach
Most Recent Surface Rupture: Holocene, offshore; Late Quaternary, onshore
Interval Between Major Ruptures: unknown
Probable Magnitudes: M6.0 - 7.0 (or greater) Fault geometries may allow only partial rupture at any one time. Depending on which segments, or combination of segments rupture, the damage to the South Bay could be moderate to severe.

Raymond Fault[13]

Nearest Communities: San Marino, Arcadia, South Pasadena
Most Recent Surface Rupture: Holocene
Interval between Major Ruptures: roughly 4500 years
Last Significant Earthquake: The 1988 Pasadena earthquake was located on this fault.
Probable Magnitudes: M6.0 – 7.0

San Andreas Fault Zone[14]

Nearest Communities: Parkfield, Frazier Park, Palmdale, Wrightmead, San Bernadino, Banning, Indio
Most Recent Surface Rupture: January 9, 1857 (Mojave Segment)
Interval between Major Ruptures: average of about 140 years on the Mojave segment; recurrence interval varies greatly – from under 20 years (Parkfield) to over 300
Probable Magnitudes: M6.8 – 8.0

San Jose Fault[15]

Nearest Communities: Claremont, La Verne, Pomona
Last Significant Quake: February 28, 1990
Most Recent Surface Rupture: Late Quaternary
Interval between Major Ruptures: unknown
Probable Magnitudes: M6.0 – 6.5

Way Hill Fault[16]

Nearest Communities: San Dimas
Last Significant Quake: 1933
Most Recent Surface Rupture: unknown
Interval between Major Ruptures: unknown
Probable Magnitudes: unknown

Whittier Fault

Nearby Communities: Yorba Linda, Hacienda Heights, Whittier
Most Recent Surface Rupture: Holocene
Interval between Major Ruptures: unknown
Probably Magnitudes: M6.0 – 7.2

Vulnerability Assessment

Since the effects of earthquakes can influence a large area, many occurring in Southern California would be felt throughout the region. However, the degree to which the earthquakes are felt, and the associated damages, vary. Large stocks of old buildings and bridges have a high-risk potential. Many high tech and hazardous materials facilities, extensive sewer, water, and natural gas pipelines; earth dams; petroleum pipelines, and other critical facilities are just a few examples of potential hazards. The relative or secondary earthquake hazards, which cause liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake.

Southern California has many active landslide areas, and a large earthquake could trigger accelerated movement in these slide areas, in addition to jarring loose other unknown areas of landslide risk. The map on the following page demonstrates the potential for liquefaction throughout the City of San Dimas.

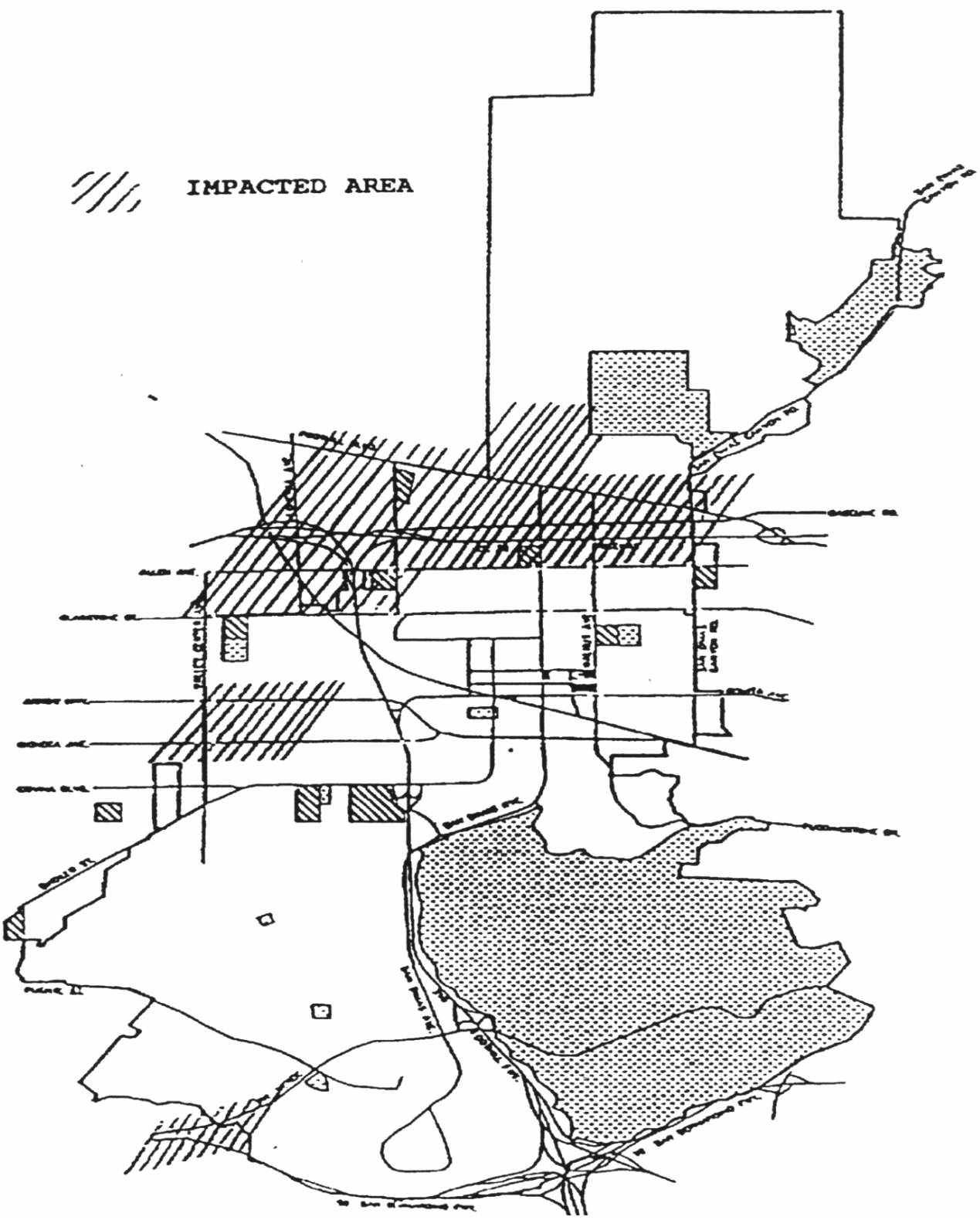
Risk Analysis

Risk analysis, the third phase of a hazard assessment, includes estimating the damage and costs likely to be experienced in a geographic area from a particular hazard.[17] Some of the factors in assessing earthquake risk are population and property distribution, the frequency of events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region. This type of analysis can generate estimates of the damages to the region due to an earthquake event in a specific location.[18]

For the greater Southern California area, there are multiple worst case scenarios, depending on the proximity to and type of fault. Unfortunately, damage will not be limited to the immediately adjoining neighborhoods, as seismic waves often affect distant communities. For example, during the 1994 Northridge earthquake, Santa Monica suffered extensive damage, although there is a range of mountains between the City and the origin of the earthquake.

Damages for a large earthquake in Southern California are likely to run into the billions of dollars. Although building codes for new structures in the region are some of the most stringent in the world, thousands of older existing buildings were built under much less rigid codes. Although California aimed at modernizing unreinforced masonry buildings (URM's), hundreds of buildings have not been brought up to current standards.

Map 6-3: Liquefaction Potential in San Dimas



While San Dimas only has eight URM's, it is important that the City strive to improve them. Non-structural bracing of equipment and contents is often the most cost-effective type of seismic

mitigation. Non-structural bracing of equipment and furnishings will also reduce the chance of injury for the occupants of a building.

In a preliminary risk assessment for earthquakes, the City of San Dimas has projected $4.24 billion worth of infrastructure in the hazard area. This estimate was calculated using census data for the average value of residential structures, as well as various tax data for other types of structures. Any new developments in the City will also be located within this hazard area. Since 100% of the City's buildings fall within this zone, a major earthquake has the potential to cause catastrophic damage.

Table 6-2 Infrastructure Assessment: Earthquakes

Land Use	Units in Hazard Area	Percentage in Hazard Area	Value in Hazard Area
Residential	9270	100%	$3.7 billion
Commercial	268	100%	$316 million
Industrial	120	100%	$189 million
Religious / Non-Profit	10	100%	$18 million
Government	2	100%	$16 million
Education	3	100%	NA
Utilities	NA	NA	NA
Agricultural	NA	NA	NA
Total	9673	100%	$4.24 billion

The following section outlines potential damages in case of a major earthquake. It is essential that the City and its residents are aware of these vulnerabilities in order to their effects.

Community Earthquake Issues-What is Susceptible to Earthquakes?

Earthquake damage usually occurs because structures cannot withstand severe shaking. As a result, buildings, schools, and lifelines (highways and utility lines) suffer damage in earthquakes and can cause death or injury. Addressing the reliability of buildings, critical facilities, and infrastructure, while understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by the City.

Dams and Reservoirs

There are a total of 103 dams and reservoirs in Los Angeles County, owned by 23 agencies or organizations, ranging from the Federal government to Home Owner Associations.[19] There are two reservoirs in the City of San Dimas, the Puddingstone and San Dimas Canyon Reservoirs. Releases of water from the major reservoirs are designed to protect Southern California from flood and to store domestic water. Seismic activity can compromise the dam structures, and the resultant flooding could cause catastrophic. Following the 1971 Sylmar earthquake, the Lower Van Norman Dam showed signs of structural compromise, and thousands of residents had to be evacuated until the dam could be drained. It has never been refilled.

Buildings
The infrastructural environment in the City of San Dimas is susceptible to damage from earthquakes. Collapsed buildings can trap and bury people. In most California communities, many buildings were built before 1993 when building codes were less constrictive. In addition, retrofitting is not required except under certain conditions and can be expensive. As a result, the number of buildings at risk remains high. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of unreinforced masonry buildings. While there has been some limited building damage in San Dimas following an earthquake, there has not been an entire collapse in recent history.

Infrastructure and Communication
As mentioned in the community profile, residents in the City of San Dimas commute frequently by automobiles and public transportation such as buses and light rail. An earthquake can greatly damage bridges and roads, hampering emergency response efforts and the normal movement of people and goods. Damaged infrastructure strongly affects the economy of the community because it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers,

Modern bridges can also sustain damage during earthquakes, leaving them unsafe for use. In some instances, bridges have failed completely due to strong ground motion. Bridges are a vital transportation link, and even minor damages making some areas inaccessible. Because bridges vary in size, materials, location and design, any given earthquake will affect them differently. Bridges built before the mid-1970s have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980 when design improvements were made.

Most of the interstate highway system was built in the mid to late 1960's. The bridges in the City of San Dimas are City, County, and State owned (including railroad bridges).[20] CalTrans has retrofitted most bridges on the freeway systems, however there are still some county maintained bridges in the area that are that are not retrofitted. The FHWA requires that bridges on the National Bridge Inventory be inspected every two years. CalTrans checks when the bridges are inspected because they administer the Federal funds for bridge projects.

Damage to Lifelines
Lifelines are the connections between communities and outside services. They include water, gas lines, transportation systems, and electricity and communication networks. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. Lifelines need to be functional after earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

Disruption of Critical Services
Critical facilities include police stations, fire stations, hospitals, shelters, and other amenities that provide important services to the community. These facilities and their services need to be

operating after an earthquake event. Many of these necessities are housed in older buildings that are not up to current seismic codes.

Businesses
Seismic activity can cause great loss to businesses, including both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to shop owners who may have difficulty recovering from their losses.

Forty percent of small businesses do not reopen after a disaster and another twenty-five percent fail within one year according to the Federal Emergency Management Agency (FEMA). Similar statistics from the United States Small Business Administration indicate that over ninety percent of businesses fail within two years after being struck by a disaster.[21]

Individual Preparedness
Because the potential for earthquake occurrences and earthquake related property damage is relatively high in San Dimas, increasing individual preparedness is necessary. Securing heavy furniture, water heaters, and expensive personal property, as well as anchoring buildings to foundations, are just a few steps individuals can take to prepare for an earthquake.

Unfortunately, both death and injury can occur both inside and outside of buildings due to collapsed buildings falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life.

Fire
After an earthquake, downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to extinguish fires is less likely. Furthermore, major incidents will demand a larger share of resources, and initially smaller fires and problems will receive little or insufficient resources in the initial hours after a major earthquake event. Loss of electricity may cause a loss of water pressure in some communities, further hampering fire fighting ability.

Debris
After damage to a variety of structures, a great amount of time is spent cleaning up brick, glass, wood, steel building elements, office and home contents, and other materials. Developing a strong debris management strategy is essential in post-disaster recovery. Occurrence of a disaster does not exempt the City from compliance with AB 939 regulations.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that have been implemented by City, county, regional, state, or federal agencies.

City of San Dimas Codes

Implementation of earthquake mitigation policy most often takes place at the local government level. The City's Department of Building and Safety enforces the following building codes pertaining to earthquake hazards.

The following sections of the CBC address the earthquake hazard:

1605. 1	Distribution of Horizontal Sheer
1605.2	Stability against Overturning
1626	Seismic
1605.3	Anchorage
1633.9	Pertain to specific earthquake hazards

In addition, the City has adopted specific amendments to the Uniform Code addressing the increased risk of damages caused by earthquakes. Ordinance 1126 amended various building codes concerning flooding, windstorms, and earthquakes. Because San Dimas is in the highest earthquake potential zone in the United States (Zone 4), it is essential that all construction requires the most stringent degree of scrutiny to ensure the safety of our residents.

Generally, these codes seek to discourage development in areas that could be prone to seismic hazards, and where development is permitted, the applicable construction standards are met. Developers in hazard-prone areas may be required to retain a qualified professional engineer to evaluate level of risk on the site and recommend appropriate mitigation measures.

Some specific concerns in these amendments address footing and foundation construction. It is required that each of these be constructed of masonry or concrete, shall be supported on native undisturbed materials or approved certified fill, and shall extend below the frost line. Further requirements in Zone 4 explain that sill bolt diameter and spacing for three-story raised wood floor buildings shall be specifically designed according to building standards.

State building codes are thoroughly revised after each earthquake. For example, the Field Act, which updated school construction, resulted from the 1933 Long Beach Earthquake. Similar re-evaluations occurred after the 1971 Sylmar, 1989 Loma Prieta, and 1994 Northridge Earthquakes.

In 1972, the Alquist-Priolo Earthquake Fault Zoning Act was passed to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which led to extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Surface rupture is the most easily avoided seismic hazard.[22]

The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.[23] The State Department of Conservation operates the Seismic Mapping Program for California.

The City of San Dimas regularly updates building codes to ensure the highest level of safety. A more detailed synopsis of codes relating to earthquake safety can be found in the community issues section.

Coordination among Building Officials
The City of San Dimas Building Code sets the minimum design and construction standards for new buildings. San Dimas has adopted the most recent seismic standards in its building code, which requires that new buildings be built at the most stringent seismic standard.

The City also requires that site-specific seismic hazard investigations be performed for new essential facilities, major structures, hazardous facilities, and special occupancy structures such as schools, hospitals, and emergency response facilities.

The Seismic Safety Commission Evaluation of the State's Hospital Seismic Safety Policies
Recognizing the continuing need to assess the adequacy of policies, and the application of advances in technical knowledge and understanding, the California Seismic Safety Commission created an Ad Hoc Committee to re-examine the compliance with the Alquist Hospital Seismic Safety Act in 2001. The formation of the Committee was also prompted by the recent evaluations of hospital buildings reported to OSHPD that revealed that a roughly forty percent of California's operating hospitals are in the highest category of collapse risk.[24]

State of California Earthquake Mitigation Legislation
California is painfully aware of the threats it faces from earthquakes. Dating back to the nineteenth century, Californian residents have been killed, injured, and lost property as a result of earthquakes. As the State's population continues to grow, and urban areas become even more densely built up, the risk will continue to increase. For decades, the Legislature has passed laws to strengthen the built environment and protect the citizens. Table 6-2 provides a sampling of some of the 200 plus laws in the State's codes.[25]

Table 6-3 Partial List of California Laws on Earthquake Safety

Government Code	Description
Government Code Section 8870-8870.95	Creates Seismic Safety Commission.
Government Code Section 8876.1-8876.10	Established the California Center for Earthquake Engineering Research.
Public Resources Code Section 2800-2804.6	Authorized a prototype earthquake prediction system along the central San Andreas fault near the City of Parkfield.
Public Resources Code Section 2810-2815	Continued the Southern California Earthquake Preparedness Project and the Bay Area Regional Earthquake Preparedness Project.
Health and Safety Code Section 16100-16110	The Seismic Safety Commission and State Architect will develop a state policy on acceptable levels of earthquake risk for state-owned buildings.
Government Code Section 8871-8871.5	Established the California Earthquake Hazards Reduction Act of 1986.
Health and Safety Code Section 130000-130025	Defined earthquake performance standards for hospitals.

Public Resources Code Section 2805-2808	Established the California Earthquake Education Project.
Government Code Section 8899.10-8899.16	Established the Earthquake Research Evaluation Conference.
Public Resources Code Section 2621-2630 2621.	Established the Alquist-Priolo Earthquake Fault Zoning Act.
Government Code Section 8878.50-8878.52 8878.50.	Created the Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990.
Education Code Section 35295-35297 35295.	Established emergency procedure systems in kindergarten through grade 12 in all the public or private schools.
Health and Safety Code Section 19160-19169	Established standards for seismic retrofitting of URM buildings.
Health and Safety Code Section 1596.80-1596.879	Required all child day care facilities to include an Earthquake Preparedness Checklist as an attachment to their disaster plan.

Businesses/Private Sector

Natural hazards have a devastating impact on businesses. The Institute of Business and Home Safety has developed "Open for Business," a disaster planning toolkit to help guide businesses in preparing for and dealing with the adverse affects of natural hazards. The kit integrates protection from disasters into the company's risk reduction measures to safeguard employees, and customers. The guide helps businesses secure human and physical resources during disasters, while assisting in the development of strategies to maintain business continuity before, during, and after a disaster occurs.

Hospitals

The 1973 Alfred E. Alquist Hospital Seismic Safety Act (Hospital Act) was implemented in response to the 1971 6.6 Sylmar Earthquake, when four major hospital campuses were severely damaged and evacuated. Two hospital buildings collapsed killing forty-seven people. In approving the Act, the Legislature noted that hospitals house patients who have less capacity of to protect themselves and must be reasonably of providing services to the public after a disaster. They shall be designed and constructed to resist, the forces generated by earthquakes.[26]

When the Hospital Act was placed into law, the State anticipated that, the majority of hospital buildings would be in compliance with the Act's standards within twenty-five years. However, hospital buildings were not, and are not, being replaced at that anticipated rate. In fact, the great majority of the State's urgent care facilities are now more than forty years old.

The 1994 Northridge Earthquake caused $3 billion in hospital-related damage and evacuations. Twelve hospital buildings constructed before the Act were cited as unsafe for occupancy after the earthquake. Those hospitals that had been built in accordance with the Hospital Act were successful in resisting structural damage. However, nonstructural damage such as plumbing and ceiling systems, was still extensive in those post-1973 buildings.

Senate Bill 1953, implemented in 1994 after the Northridge Earthquake, expanded the scope of the Hospital Act. Under SB 1953, all hospitals are required, as of January 1, 2008, to withstand earthquakes without collapsing or posing the threat of significant loss of life. The 1994 Act further mandates that all existing hospitals be seismically evaluated, and retrofitted, by 2030, so

that they capable of providing services to the public after disasters. SB 1953 applies to all urgent care facilities and affects approximately 2,500 buildings on 475 campuses.

SB 1953 directed the Office of Statewide Health Planning and Development (OSHPD), in consultation with the Hospital Building Safety Board, to develop emergency regulations including earthquake performance categories with sub-gradations for risk to life, structural soundness, building contents, and nonstructural systems that are critical to providing basic services to hospital inpatients and the public after a disaster.[27]

Earthquake Education
Earthquake research and education activities are conducted at several major universities in the Southern California region, including USC, Cal Tech, UCLA, UCSB, UCI, and UCSB. The local clearinghouse for earthquake information is the Southern California Earthquake Center (SCEC). SCEC is a community of scientists and specialists who actively coordinate research on earthquakes at nine core institutions, and communicate earthquake information to the public. SCEC is a National Science Foundation Science and Technology Center and is co-funded by the United States Geological Survey (USGS).

In addition, Los Angeles, along with other Southern California counties, sponsors the Emergency Survival Program (ESP), an educational program for learning how to prepare for earthquakes and other disasters. Many school districts have very active emergency preparedness programs that include earthquake drills and periodic disaster response team exercises.

Earthquake Mitigation Action Items

The earthquake mitigation action items provide guidance on suggesting specific activities that agencies, organizations, and residents in the City of San Dimas can undertake to reduce risk and prevent loss from earthquake events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation;

Action Item 1.1: Educate and assist the public on earthquake preparedness.
Implementation Initiatives:

> *Implementation Initiative 1.1.1* Conduct a community wide earthquake preparedness exercise.
>
> *Implementation Initiative 1.1.2* Educate the public on the availability of the California Earthquake Insurance Program.
>
> *Implementation Initiative 1.1.3* Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, and businesses.

Coordinating Organizations: City Administration Department, Los Angeles County Sheriff's Department, City Building and Safety Division
Time line: Short-term, Ongoing.

Plan Goals Addressed: Increase public awareness.

Action Item 1.2: Enhance the sustainability of a functioning government during and after an earthquake.
Implementation Initiatives:

Implementation Initiative 1.2.1 Identify alternative structures to house government agencies.

Implementation Initiative 1.2.2 Encourage seismic strength evaluations of Civic Center buildings.

Coordinating Organizations: City Administration Department, City Building Division
Time line: Short-term.
Plan Goals Addressed: Strengthen City emergency services.

Action Item 1.3: Increase the number of retrofitted private structures.
Implementation Initiatives:

Implementation Initiative 1.3.1 Promote incentives, such as waiving permit fees, for retrofitting unreinforced or unanchored residential foundations.

Implementation Initiative 1.3.2 Evaluate an unreinforced masonry ordinance.

Implementation Initiative 1.3.2 Identify funding sources for structural and non-structural retrofitting of buildings that are identified as seismically vulnerable.

Coordinating Organizations: City Building Division, City Administration Department
Time line: Long-term.
Plan Goals Addressed: Protect life and property.

Earthquake Resource Directory

Local and Regional Resources

Los Angeles County Public Works Department - http://ladpw.org
900 S. Fremont Ave.
Alhambra, CA 91803
Ph: 626-458 5100
The Los Angeles County Department of Public Works protects property and promotes public safety through flood control, water conservation, road maintenance, bridges, building and safety, land development, waterworks, sewers, engineering, and airports.

Southern California Earthquake Center (SCEC) – http://www.scec.org
University of Southern California
3651 Trousdale Parkway
Suite 169
Los Angeles, CA 90089
Ph: 213-740-5843
The Southern California Earthquake Center (SCEC) gathers information about earthquakes and integrates it into a comprehensive and predictive understanding of the phenomena in order to increase earthquake awareness, reduce economic losses, and save lives.

State Resources

California Department of Transportation (CalTrans) - http://www.dot.ca.gov/
120 S. Spring Street
Los Angeles, CA 90012
Ph: 213-897-3656
CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. In partnership with Amtrak, CalTrans is also involved in the support of intercity passenger rail service in California.

California Resources Agency - http://resources.ca.gov/
416 Ninth Street
Suite 1311
Sacramento, CA 95814
Ph: 916-653 5656
The California Resources Agency restores, protects, and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration, and respect for all the communities and interests involved.

California Division of Mines and Geology (DMG) http://www.consrv.ca.gov/cgs/index.htm
801 K Street MS 12-30
Sacramento, CA 95814
Ph: 916-445-1825

The California Geological Survey develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources.

California Department of Conservation: Southern California Regional Office
http://www.consrv.ca.gov
655 S. Hope Street #700
Los Angeles, CA 90017
Ph: 213-239 0878
The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land use decisions and sound management of our state's natural resources.

Governor's Office of Emergency Services (OES) http://www.oes.ca.gov
P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911
The Governor's Office of Emergency Services coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.

Federal and National Resources

Building Seismic Safety Council (BSSC) http://www.bssconline.org
1090 Vermont Ave., NW
Suite 700
Washington, DC 20005
Ph: 202-289-7800
The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

Federal Emergency Management Agency, Region IX http://www.fema.gov
1111 Broadway
Suite 1200
Oakland, CA 94607
Ph: 510-627-7100
The Federal Emergency Management Agency is tasked with responding to, planning for, recovering from and mitigating against disasters.

Federal Emergency Management Agency, Mitigation Division
http://www.fema.gov/fima/planhowto.shtm
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600
The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has a number of programs and activities which provide citizens

Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.

United States Geological Survey - http://www.usgs.gov/
345 Middlefield Road
Menlo Park, CA 94025
Ph: 650-853-8300
The USGS provides scientific information to describe and understand the earth, and minimize loss of life and property from natural disasters. They also conduct research on managing water, biological, energy, and mineral resources, as well as enhancing our quality of life.

Western States Seismic Policy Council (WSSPC) http://www.wsspc.org/home.html
125 California Avenue
Suite D201, #1
Palo Alto, CA 94306
Ph: 650-330-1101
WSSPC is a regional earthquake consortium funded mainly by FEMA. Its website is a great resource, with information clearly categorized - from policy to engineering to education.

Institute for Business & Home Safety - http://www.ibhs.org/
4775 E. Fowler Avenue
Tampa, FL 33617
Ph: 813-286-3400
The Institute for Business & Home Safety (IBHS) is a nonprofit association that engages in communication, education, engineering and research. The Institute works to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.

Publications

Land Use Planning for Earthquake Hazard Mitigation: Handbook for Planners. Wolfe, Myer R. et.al. 1986. University of Colorado Institute of Behavioral Science, National Science Foundation.

This handbook provides techniques that planners can utilize to help mitigate for seismic hazards, It provides information on the effects of earthquakes, sources on risk assessment, and effects of earthquakes on the built environment. The handbook also gives examples on application and implementation of planning techniques to be used by local communities.
Natural Hazards Research and Applications Information Center
University of Colorado, 482 UCB,
Boulder, CO 80309-0482
Phone: (303) 492-6818
Website: http://www,colorado.edu/UCB/Research/IBS/hazards
Public Assistance Debris Management Guide, FEMA (July 2000). The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing. and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county

emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities.

---

[1] Southern California Earthquake Center. http://www.scec.org
[2] http://pubs.usgs.gov/gip/earthq3/when.html

[3] SCEC. http://www.scec.org

[4] http://geology.about.com
[5] http://www.gps.caltech.edu/~sieh/home.html
[6] Ibid

[7] Planning for Natural Hazards: The California Technical Resource Guide, Department of Land Conservation and Development (July 2000)

[8] United States Geological Survey
[9] www.data.scec.org/fault_index/clamshel.html.
[10] http://www.data.scec.org/fault_index/cucamong.html
11 **http://www.data.scec.org/fault_index/newping.html**

[12] http://www.data.scec.org/fault_index/palos.html

[13] http://ww.data.scec.org/fault_index/raymond.html
[14] http://www.data.scec.org/fault_index/sanandre.html
[15] http://www.data.scec.org/fault_index/sanjose.html
[16] EIR - Target Shopping Center. pg. 7. April 25, 1995

[17] Burby, R. (Ed.) Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities (1998), Washington D.C., Joseph Henry Press.

[18] FEMA HAZUS http://www.fema.gov/hazus/hazus2.htm (May 2001).

[19] Los Angeles County Public Works Department, March 2004

[20] The City of San Dimas Department of Public Works.
[21] http://www.chamber101.com/programs_committee/natural_disasters/DisasterPreparedness/Forty.htm

[22] http://www.consrv.ca.gov/CGS/rghm/ap/

[23] Ibid

[24] http://www.seismic.ca.gov/pub/CSSC_2001-04_Hospital.pdf

[25] http://www.leginfo.ca.gov/calaw.html
[26] California Health and Safety Code Section 129680
[27] Health and Safety Code Section 130005

7 Why are Landslides a Threat to City of San Dimas?

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year.[1] Landslide damage in the United can cost up to $2 billion annually![2] As a seismically active region, California has had significant number of locations impacted by landslides. Some result in private property damage, while other landslides affect transportation corridors, fuel and energy conduits, and communication facilities. They also pose a serious threat to human life.

As Map 7-1 indicates, several portions of the City are susceptible to liquefaction. These areas are primarily situated in the foothills, but fortunately, since the settlement of the City in the 1800's, there have been few instances of liquefaction associated with seismic activity.

Historic Southern California Landslides

Throughout the 20th century, there has been a number of damaging landslides throughout the region. These slides are usually a result of high quantities of rain, but are extremely unpredictable. Some of the highest costing landslides are described in the following section.[3]

March 1928 St. Francis Dam failure, Los Angeles County[4]
As the dam gave way, its waters swept through the Santa Clara Valley toward the Pacific Ocean, about fifty-four miles away. Sixty-five miles of valley was devastated, and over 500 people were killed. Damages were estimated at $672.1 million.[5]

1956 Portuguese Bend, California
Cost: $14.6 million along California Highway 14 in Palos Verdes Hills. Land use on the Palos Verdes Peninsula consists mostly of single-family homes built on large lots. All of the houses were constructed with individual septic systems, generally with septic tanks and seepage pits. The Portuguese Bend landslide began its modern movement in August 1956, when displacement was noticed at its northeast margin. Movement gradually extended downslope so that the entire eastern edge of the slide mass was moving within 6 weeks. By the summer of 1957, the entire slide mass was sliding towards the sea.[6]

1958-1971 Pacific Palisades
Cost, $29.1 million along California Highway 1. One house damaged.[7]

1961 Mulholland Cut, Los Angeles County
Cost, $41.5 million on Interstate 405, 11 miles north of Santa Monica, Los Angeles County.[8]

December 1963 Baldwin Hills Dam Failure
The 650 foot long by 155-foot high earth fill dam gave way and sent 360 million gallons of water

in a fifty-foot high wall cascading onto the community below, killing five persons, and damaging $50 million (1963 dollars) in property.[9]

1969 Glendora, Los Angeles County
Cost, $26.9 million, Los Angeles County, 175 houses damaged by debris flows.[10]

1969 Seventh Ave., Los Angeles County
Cost, $14.6 million, California Highway 60.[11]

1970 Princess Park
Cost, $29.1 million, California Highway 14, 10 miles north of Newhall.[12]

1971 Upper and Lower Van Norman Dams, San Fernando
Earthquake-induced landslides Cost, $302.4 million. Damage due to the February 1971, M7.5 San Fernando, California, earthquake.[13]

1971 Juvenile Hall, San Fernando
Cost, $266.6 million caused by the San Fernando Earthquake. In addition to damaging the San Fernando Juvenile Hall, this 1.2 km-long slide damaged trunk lines of the Southern Pacific Railroad, San Fernando Boulevard, Interstate Highway 5, the Sylmar electrical converter station, and several pipelines and canals.[14]

1977-1980 Monterey Park, Repetto Hills, Los Angeles County
Cost, $14.6 million. One hundred houses damaged in 1980 due to debris flows.[15]

1978 Bluebird Canyon Orange County
Cost, $52.7 million. Sixty houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the slide area was only 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.[16]

1979 Big Rock, California, Los Angeles County
Cost, approximately $1.08 billion, California Highway 1 rockslide.[17]

February 1980 Southern California slides
$1.1 billion in damage. Heavy winter rainfall in 1979-80 caused damage in six Southern California counties. As much as 8 inches of rain fell in a 6 hour period in many locations. Observations in the field on February 16 and 17 showed that the mountains and slopes literally fell apart on those two days.[18]

1983 San Clemente, Orange County
Cost, $65 million. Litigation also involved approximately $43.7 million.[19]

1983 Big Rock Mesa
Cost, $706 million in legal claims condemnation of 13 houses, and 300 more threatened rockslide caused by rainfall.[20]

1978-1980 San Diego, Orange and Los Angeles Counties
Cost, in excess of $1 million. One hundred and twenty landslides were reported to have occurred in San Diego during these 2 years. Rainfall for 78-79 and 79-80 was 14.82 and 15.61 inches respectively, compared to a 125-year average of 9.71 inches. Of the nine landslides, seven occurred in the Friars Formation, and two in the Santiago Formation in San Diego County.[21]

1994 Northridge, California earthquake landslides[22]
As a result of the magnitude 6.7 Northridge Earthquake, more than 11,000 landslides occurred over an area of 10,000 km^2. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. They destroyed dozens of homes, blocked roads, and damaged oil-field infrastructure. Numerous deaths resulted from Coccidioidomycosis (valley fever), from a spore which was released from the soil and blown toward the coastal populated areas.[23]

March 1995 Los Angeles and Ventura Counties
Above normal rainfall triggered damaging debris flows, deep-seated landslides, and flooding. Several landslides were triggered by the storms, with the most notable being the La Conchita landslide. This slide destroyed or badly damaged 12 homes. There also was widespread debris-flow and flood damage to homes, buildings, and roads in areas along the coast that had been devastated by wildfire 2 years before.[24]

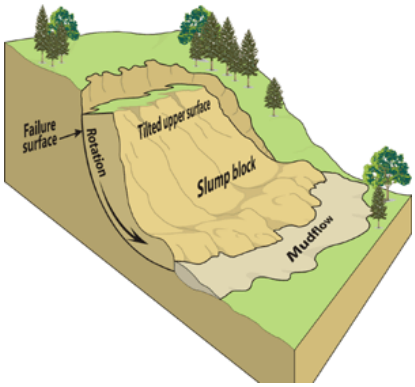
Landslide Characteristics

What is a landslide?
A landslide can be defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of mass wasting which denotes any down slope movement of soil and rock under the direct influence of gravity. The term landslide encompasses events such as rock falls, topples, slides, spreads, and flows. Natural events such as rainfall, earthquakes, and changes in slope, as well as manmade construction activities can initiate landslides. While improbable in San Dimas, landslides can also occur underwater.[25]

The size of a landslide usually depends on the geology and the initial cause of the event. Landslides vary greatly in their volume of rock and soil, the length, width, depth of the area affected, frequency of occurrence, and movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. The slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious

injuries than rapidly moving landslides.[26]

Failure of a slope occurs when the force that is pulling the slope downward exceeds the strength of the earth materials that compose the slope.[27] They can move slowly (millimeters per year), or can move with disastrous speed. Depending on the slope angle, water content, and type of earth, debris-flows can travel down a hillside of speeds from as slow as 30 mph up to 200 miles per hour. These flows are initiated by heavy, usually sustained, periods of rainfall, but sometimes as a result of short bursts of concentrated rainfall in susceptible areas. Burned regions charred by wildfires are particularly susceptible to debris flows.[28]



What is a Debris Flow?
A debris or mudflow is a river of rock, earth and other materials, including vegetation that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows often with speeds greater than 20 mile per hour, and can often move much faster.[29] This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Landslide Events and Impacts

Weathering and the decomposition of geologic materials produces conditions conducive to landslides further exacerbates many landslide problems. Many landslides are difficult to mitigate, particularly in areas of large movement with weak underlying geologic resources.

The increasing scarcity of buildable land, particularly in urban areas, increases the tendency to build on geologically marginal land. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Even with proper planning, landslides will continue to threaten the safety of people, property, and infrastructure, but without the proper measures, landslide hazards will be even more destructive.

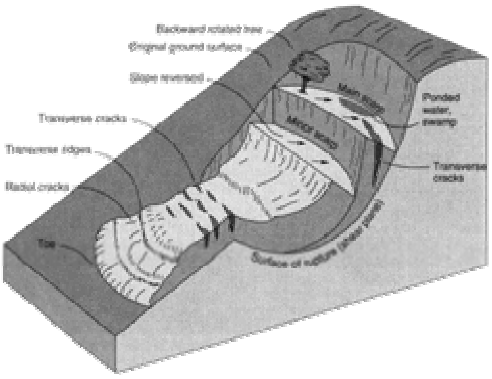
Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

Earth flows are plastic or liquid movements in which land mass breaks up and flows during movement.[30] Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel.[31] Flows often occur during heavy rainfall, can occur on gentle slopes, and are able to move rapidly for long distances.

Landslide Conditions

Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flow, and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Locating development near steep slopes can also increase susceptibility to landslide events.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities.[32] Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.[33]



Wild fires in hills covered with chaparral are often a precursor to debris flows in burned out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water by creating a waxy-like layer just below the ground surface. Since the water cannot be absorbed into the soil, it rapidly accumulates on slopes, often gathering loose particles of soil in to a sheet of mud and debris. Debris flows can often originate miles away from unsuspecting persons, and approach them at a high rate of speed with little warning.

Natural Conditions

Natural processes can cause landslides or re-activate historical landslide sites. The removal or undercutting of shoreline-supporting material along bodies of water by currents and waves produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks.

Particularly Hazardous Landslide Areas

Locations at risk from landslides or debris flows include areas with the following conditions:

- On or close to steep hills
- Steep road-cuts or excavations
- Existing landslides or places of known historic landslides Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons
- Canyons below hillside and mountains that have recently been subject to wild fire

Impacts of Development

Although landslides are a natural occurrence, human impacts can substantially affect the potential for landslide failures in San Dimas. Proper planning and geotechnical engineering can be exercised to reduce the threat of safety of people, property, and infrastructure.

Excavation and Grading
Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below new construction sites are indicators of the potential impacts stemming from excavation.

Drainage and Groundwater Alterations
Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area; Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.[34]

Changes in Vegetation
Removing vegetation from very steep slopes can increase landslide hazards. Areas that experience wildfire and land clearing for development may have long periods of increased landslide hazard. In addition, certain types of ground cover have a much greater need for constant watering to remain green, especially those that are non-native to the area.

Landslide Hazard Assessment

Hazard Identification

Identifying hazardous locations is an essential step towards implementing more informed mitigation activities**.** There is a low potential for liquefaction in San Dimas, however there are certain areas that are prone to this hazard, as identified in Map 7-1. Soils most prone to liquefaction are medium to fine san fractions in areas where the water table is high. Since these unfavorable conditions overlap in only a few areas in the community, the risk is relatively low.

The area north of Way Hill, southeast of the spreading grounds, the central-southwestern border, and the flood plains of San Dimas Wash near the western-central part of the City are at high risk for landslides.

Vulnerability and Risk

Vulnerability assessment for landslides will assist in predicting how different types of property and population groups will be affected by a hazard.[35] Data that includes specific landslide-prone and debris flow locations in the city can be used to assess the population and total value of property at risk from future landslide occurrences.

After evaluating the liquefaction areas in San Dimas, the City has estimated that approximately 1% of existing buildings are located in these zones. One hundred percent of these structures are residential, and their total value is roughly $40 million.[36] At the time of publication for this Plan, there were no plans for future development in the hazard area. As the NHMP is updated, new developments shall be included. Luckily, while landslides could be a potentially disastrous problem, their probability is extremely low within the City.

Table 7-1 Infrastructure Assessment: Landslide

Land Use	Units in Hazard Area	Percentage in Hazard Area	Value in Hazard Area
Residential	100	1%	$40 million
Commercial	0	0	0
Industrial	0	0	0
Religious / Non-Profit	0	0	0
Government	0	0	0
Education	0	0	0
Utilities	NA	NA	NA
Agricultural	NA	NA	NA
Total	100	1%	$40 million

While a complete quantitative vulnerability assessment has not yet been conducted for City of San Dimas landslide events, there are many qualitative factors that point to potential vulnerability. Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damages to the city due to a specific landslide or debris flow event. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

Community Landslide Issues - What is Susceptible to Landslides?

Landslides can affect utility services, transportation systems, and critical lifelines resulting in immediate damages and loss of service. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs.

Loss of electricity has the most widespread impact on other utilities and on the City. Natural gas pipes may also be at risk of breakage from even minute landslide movements.

Roads and Bridges
Losses incurred from landslide hazards in the City of San Dimas have been associated with roads. Public Works is responsible for responding to slides that inhibit the flow of traffic or are damaging a road or a bridge. The Department does its best to communicate with residents impacted by landslides, but can usually only repair the road itself, as well as the areas adjacent to the slide where the city has the right of way.

It is not cost effective to mitigate all slides because of limited funds and the fact that some historical slides are likely to become active again even with mitigation measures. The City alleviates problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides. This type of response activity is often the most cost-effective in the short-term, but is only temporary. Unfortunately, many property owners are unaware of slides and the dangers associated with them.

Lifelines and critical facilities
Lifelines and critical facilities should remain accessible, if possible, during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is critical for hospitals and other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines that are located in vulnerable soils.

Existing Landslide Mitigation Activities

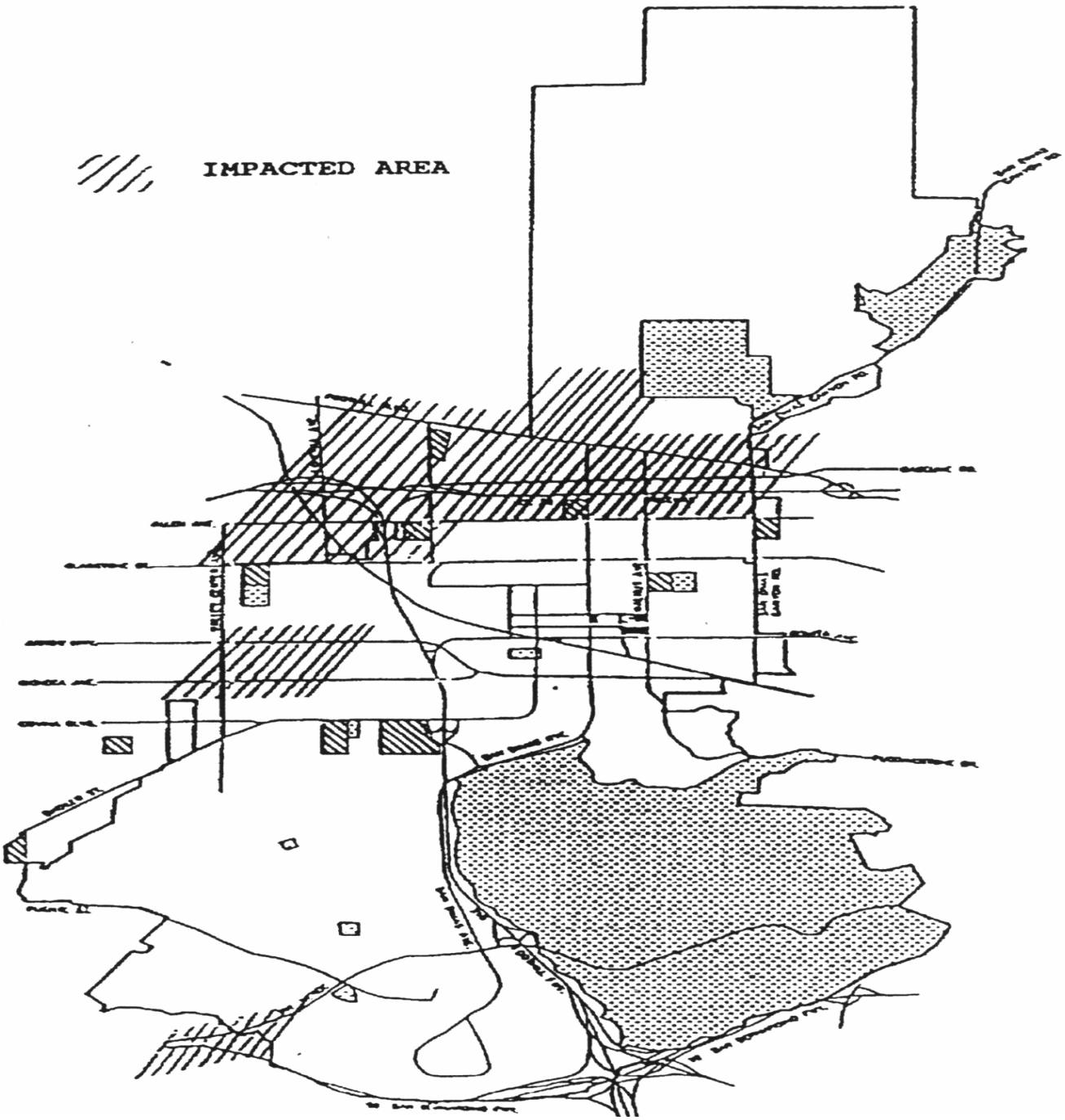
Landslide mitigation activities include current mitigation programs and activities that are being implemented by local or city organizations.

Landslide Building/Zoning Codes
The San Dimas Municipal Code addresses development on steep slopes in Section 17. This section outlines standards for steep slope hazard areas on slopes of 20 percent or more. Since the City is in the highest seismic zone in the United States, the codes require soils and engineering geologic studies for all developments proposed, regardless of slope stability. Stringent amendments to these codes were adopted in Ordinance No. 1126 in 2002. Detailed surface and subsurface investigations shall be warranted if indicated by engineering and geologic studies to sufficiently describe existing conditions. This may include soils, vegetation, geologic formations, and drainage patterns.

Post Fire Mitigation Activities
As mentioned in the introduction, the northern Foothills in and above the City were ravaged in

the 2002 Williams fire. Much of the area suffered a significant loss of vegetation. Post fire mitigation that both the City and the National Forest Service implemented a number of reduced the potential impacts of debris flows in the following rainy season. Two trash racks were installed upstream of Sycamore Canyon and Hamms Canyon to trap large debris before it entered populated areas. Pipes in the San Dimas Canyon dip crossing were modified to handle larger volumes of water and debris. K-rails and sand bags were placed at strategic locations prior to the rain season to divert debris flows away of roadways and structures. The City provided residents in the area with free sand and sand bags for use on their private property. These mitigation measures were successful in minimizing damage during the rains that have occurred in the last two years since the Williams fire.

Map 7-1 Liquefaction Potential in San Dimas



Landslide Mitigation Action Items

The action items provide direction on specific activities that the City and residents can undertake to reduce risk and prevent loss from landslide events. Each action item is followed by initiatives for implementation, which can be used by the Steering Committee and local decision makers.

Action Item 2.1: Provide education outreach on the dangers of potential landslides.
Implementation Initiatives:

> *Implementation Initiative 2.1.1* Provide information on vegetation and rodent control on slopes.

Coordinating Organizations: City Public Works Department
Time line: Short term.
Plan Goals Addressed: Increase public awareness.

Action Item 2.2: Increase emergency preparedness specific to landslides.
Implementation Initiatives:

> *Implementation Initiative 2.2.1* Continue to supply various locations with free sandbags and sand.
>
> *Implementation Initiative 2.2.2* Maintain the existing stockpile of k rails and update staging plans
>
> *Implementation Initiative 2.2.3* Develop an evacuation plan for Sycamore Canyon Equestrian Center.
>
> *Implementation 2.2.4* Maintain a database of debris basins from LA County Public Works and monitor the ongoing threat of sediment overflow.
>
> *Implementation 2.2.5* Include a USGS layer on GIS system to maintain a database of properties subject to landslide liquefaction.
>
> *Implementation 2.2.6* Develop an Action Plan to address the risk of isolation for residents in San Dimas Canyon because evacuation routes may be blocked by landslides.

Coordinating Organizations: Public Works, LA County Sheriff's Dept., Administration Dept.
Time line: Short-term
Plan Goals Addressed: Strengthen City emergency services.

Action Item 2.3: Reduce the risk of landslides in San Dimas Canyon, Sycamore Canyon and Hamm's Canyon.
Implementation Initiatives:

Implementation Initiative 2.3.1 Continue to require soils engineer's reports for new construction.

Implementation Initiative 2.3.2 Evaluate the potential for upgrade or replacement of identified bridge crossings.

*Implementation Initiative 2.3.3*Evaluate the potential for street intersection upgrades at Sycamore Canyon Road and San Dimas Canyon Road.

Coordinating Organizations: City Public Works Department
Time line: Long-term
Plan Goals Addressed: Protect life and property.

Action Item 2.4: Mitigate post fire debris flow.
Implementation Initiatives:

Implementation Initiative 2.4.1 Continue to supply various locations with free sand and sandbags.

Implementation Initiative 2.4.2 Continue to maintain the stockpile of k rails and update staging plans.

Implementation Initiative 2.4.3 Amend lease agreements with private property owners for the continued placement of trash racks in the canyons. Continue to monitor and maintain the trash racks.

Implementation Initiative 2.4.4 Monitor existing capacities and sediment flows with LA County Public Works.

Coordinating Organizations: City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Strengthen City emergency services.

Landslide Resource Directory

County Resources

Los Angeles County Department of Public Works
213-978-0265
http://www.lacity.org/DPW/dpwhome.htm

State Resources

Department of Conservation Headquarters
801 K Street, MS 24-01
Sacramento, CA 95814
(916) 322-1080
http://www.consrv.ca.gov/index/

California Geological Survey Headquarters
801 K Street, MS 12-30
Sacramento, CA 95814
(916) 445-1825
http://www.consrv.ca.gov/cgs/

California Division of Forestry
1416 9th Street PO Box 944246
Sacramento California 94244-2460
(916)653-5123
http://www.fire.ca.gov/php/

Department of Water Resources
P. O. Box 942836,
Sacramento, CA 94236
http://wwwdwr.water.ca.gov/

Governor's Office of Emergency Services
3650 Schriever Avenue
Mather, CA 95655
http://www.oes.ca.gov

California Department of Transportation (Cal Trans)
100 S. Main Street
Los Angeles, CA 90012
http://www.dot.ca.gov/

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)
1111 Broadway, Suite 1200
Oakland, CA 94607
(510) 627-7100
http://www.fema.gov

US Geological Survey, National Landslide Information Center
Placer Hall
6000 J Street, Room 4000
Sacramento, CA 95819-6129
(916) 278-3000
http://www.usgs.gov/

Publications

Olshansky, Robert B., *Planning for Hillside Development* (1996) American Planning Association. This document describes the history, purpose, and functions of hillside development and regulation and the role of planning, and provides excerpts from hillside plans, ordinances, and guidelines from communities throughout the US.

Olshansky, Robert B. & Rogers, J. David, *Unstable Ground: Landslide Policy in the United States* (1987) Ecology Law Quarterly.

Public Assistance Debris Management Guide (July 2000) Federal Emergency Management Agency. The Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations.

USGS Landslide Program Brochure. National Landslide Information Center (NLIC), United States Geologic Survey. The brochure provides general information on the importance of landslide studies and a list of databases, outreach, and exhibits maintained by the NLLC. The brochure also includes information on the causes of landslides, rock falls, and earth flows.

---

1. Mileti, Dennis, *Disasters by Design: A Reassessment of Natural Hazards in the United States* (1999) Joseph Henry Press, Washington D.C.

2. Brabb, E.E., and B.L Harrod. (Eds) *Landslides: Extent and Economic Significance. Proceedings of the 28th International Geological Congress Symposium on Landslides.* (1989) Washington D.C., Rotterdam: Balkema.

[3] Costs are listed at 2000 dollars unless otherwise noted.

[4] Picture is courtesy of
http://www.csupomona.edu/~rcaulkins/Learning_from_the_Past/St.%20Francis%20Dam%20Failure.jpg

5 Highland, L.M., and Schuster, R.L., *Significant Landslide Events in the United States.* (No Date) USGS, Washington D.C., http://landslides.usgs.gov.html_files/pubs/report1/Landslides_pass_508.pdf

6. Ibid.

7. Ibid.

8. Ibid.
[9] Ibid.

10. Ibid.

11. Ibid.

12. Ibid.

13. Ibid.

14. Ibid.
15. Ibid.

16. Ibid.

17. Ibid.

18. Ibid.

19. Ibid.

20. Ibid.

21. Ibid.
[22] picture courtesy of http://landslides.usgs.gov/html_files/landslides/slides/slide21.jpg&imgrefur

23. Ibid.

24. Ibid.

25. Landslide Hazards, U.S. Geological Survey Fact Sheet 0071-00, Version 1.0, U.S. Department of the Interior - U.S. Geological Survey, http://pubs.usgs.gov/fs/fs-0071-00/

26. Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan* (2000) Oregon Emergency Management
[27] http://www.nrcan.gc.ca/gsc/calgary/geoscape/topics/images/slopes

28. Ibid.

29. Barrows, Alan and Smith, Ted, DMG Note 13, http://www.consrv.ca.gov/cgs/information/publications/cgs_notes/note_33/

30. Robert Olson Associates, *Metro Regional Hazard Mitigation and Planning Guide* (June 1999) Metro

31. Ibid.
[32] picture is courtesy of http://www.ussartf.org/images/LandslideDiagram.gif

33. Planning For Natural Hazards: *The Oregon Technical Resource Guide*, Department of Land Conservation and Development (2000), Ch 5.

34. *Homeowners Guide for Landslide Control, Hillside Flooding, Debris Flows, Soil Erosion*, (March 1997)

35. Burby, R. (Ed.) *Cooperating With Nature* (1998) Washington, D.C.: Joseph Henry Press.
[36] This number was calculated using the average value of a home in San Dimas, according to 2000 Census data.

8 Why are Floods a Threat to the City of San Dimas?

Because of its proximity to the San Gabriel River, San Dimas can be susceptible to flooding events. Not only does flooding pose a threat to life and safety, but also can cause severe damage to public and private property. San Dimas has three flood zone designations, A, B, and C, as evident by the flood zone map. Flood Zone A, which is subject to flooding in a hundred year storm, covers a small stretch of the San Dimas Canyon Wash south of Golden Hills Road. Areas included in Flood Zone B, which could be affected in a 100 – 500 year storm, are located along the San Dimas Canyon Wash and just south and west of the Foothill Freeway north of Arrow Highway. The balance of the City is within a Flood C designation, defined as subject to minimal flooding. Map 8-1 illustrates the flood prone areas in the City.

The City of San Dimas was most recently affected by the flooding that occurred following the Williams Fire of 2002. The Williams Fire burned over 37,000 acres of forestland and 100% of the undeveloped watershed tributary to the San Dimas reservoir, which provides flood control functions for residents downstream of the facility. This tragedy greatly increased the potential for sedimentation problems to occur at the San Dimas Reservoir for the next several years. The storms following the fire resulted in a loss of electricity, water, and phone service. Over 600,000 tons of debris, silt, and rocks invaded the local neighborhoods.

Following the Williams Fire, the City filed for federal and county assistance for both fire relief and flood mitigation efforts. Fortunately, because of the large amount of prior planning done by the City of San Dimas, effects of the floods were mitigated.

History of Flooding in the City of San Dimas

While floods have not been a tremendous problem in the City of San Dimas, the City is susceptible to flooding from the Puddingstone Diversion Dam and the San Dimas Canyon River.

There are a number of rivers in the Southern California region, but the most prominent is the Los Angeles River. The flood history of the Los Angeles River is generally indicative of the flood history of much of Southern California.

Historic Flooding in Los Angeles County

Records show that since 1811, the Los Angeles River has flooded 30 times, on average once every 6.1 years. However, averages are deceiving, for the Los Angeles basin goes through periods of drought and then periods of above average rainfall. Between 1889 and 1891, the River flooded annually, and from 1941 to 1945, the River flooded 5 times. Conversely, from 1896 to 1914, a period of 18 years, and again from 1944 to 1969, a period of 25 years, the river did not have any serious floods.[1] Table 8-1 lists major floods of the LA River since 1811.

Map 8-1 Flood Zones in San Dimas

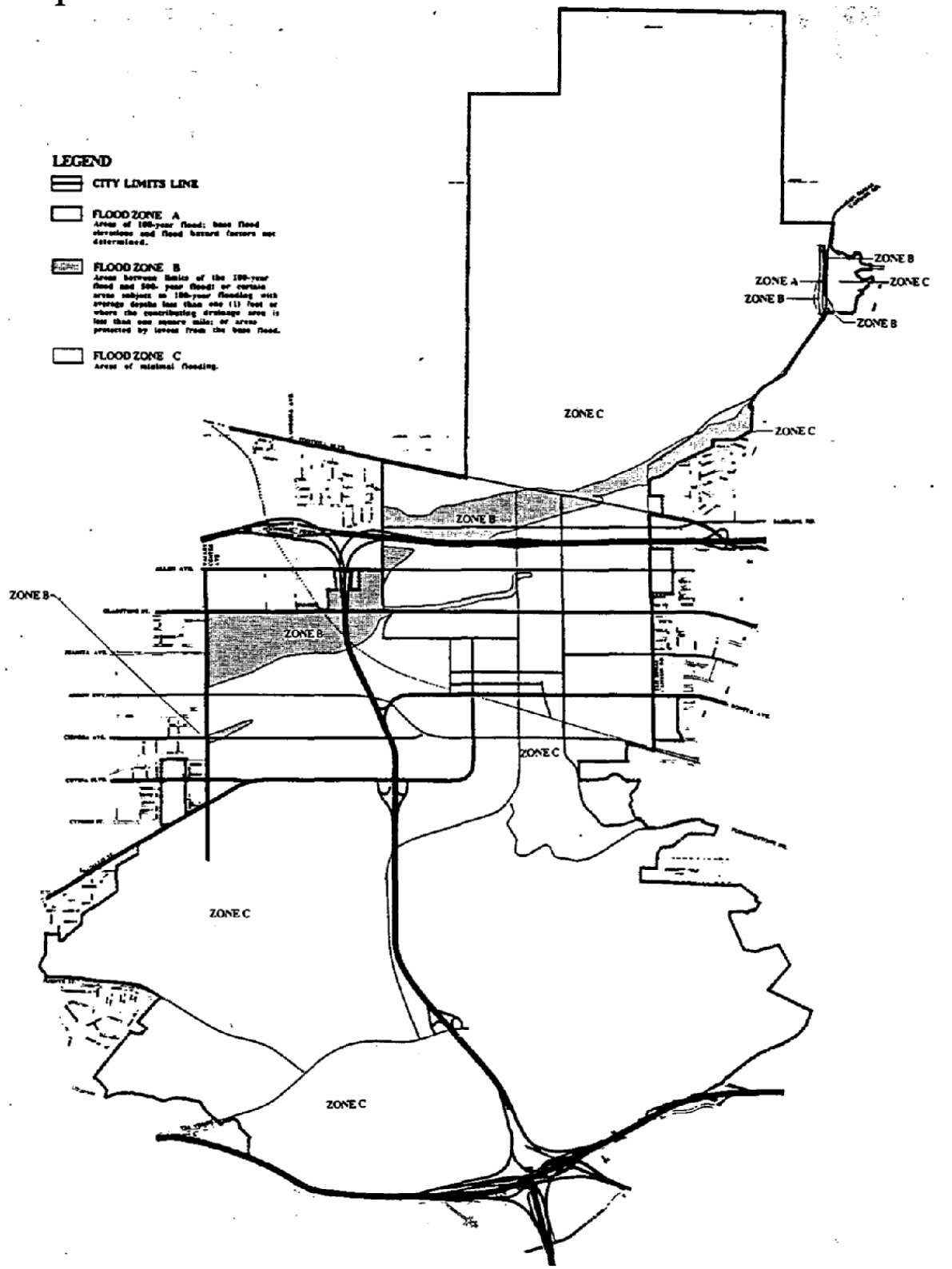


Table 8-1 Major Floods of the Los Angeles River[2]	
1811	Flooding
1825	L.A. River changed its course back from the Ballona wetlands to San Pedro
1832	Heavy flooding
1861-62	Heavy flooding, fifty inches of rain during December and January.
1867	Floods create a large, temporary lake out to Ballona Creek.
1876	The Novician Deluge
1884	Heavy flooding causes the river to change course
1888-1891	Annual floods
1914	Heavy flooding. Great damage to the harbor.
1921	Flooding
1927	Moderate flood
1934	Moderate flood starting January 1. Forty dead in La Canada.
1938	Great County-wide flood with 4 days of rain. Most rain on day 4.
1941-44	L.A. River floods five times.
1952	Moderate flooding
1969	One heavy flood after 9 day storm. One moderate flood.
1978	Two moderate floods
1979	Los Angeles experiences severe flooding and mudslides.
1980	Flood tops banks of river in Long Beach. Sepulveda Basin spillway almost opened.
1983	Flooding kills six people.
1992	15 year flood. Motorists trapped in Sepulveda basin. Six people dead.
1994	Heavy flooding

While the City of San Dimas is 25 miles east of Los Angeles, it is close enough to be affected by the heavy rains that bring flooding to the area. The towering mountains that give the Los Angeles region its spectacular views also wring heavy amounts rain out of the storm clouds that pass through. Because the mountains are so steep, the rainwater moves rapidly down the slopes and across the coastal plains on its way to the ocean.

Naturally, this rainfall moves quickly down stream, often with severe consequences for anything in its path. In extreme cases, flood-generated debris flows will roar down a canyon at speeds of 40 mph with a thick wall of mud, debris, and water. In Southern California, stories of floods, debris flows, and tragedies concerning persons swept away to their death in a river are without

end. No catalog of chaos could contain all the losses suffered by man and his possessions from the regions' rivers and streams.

What Factors Create Flood Risk?

Flooding occurs when climate, geology, and hydrology combine to create conditions where water flows outside of its usual course. In San Dimas, geography and climate combine to create chronic seasonal flooding conditions. The City is particularly susceptible to flooding each year between November and March, during the rainy reasons.

Winter Rainfall

Over the last 125 years, the average annual rainfall in Los Angeles is 14.9 inches. However, as previously discussed, the term average means very little as the annual rainfall during this period has ranged from only 4.35 inches in 2001-2002 to 38.2 inches in 1883-1884. In fact, in only fifteen of the past 125 years, has the annual rainfall been within 10% of the 14.9-inch average. In addition, only 38 years have had annual rainfall of 20% of the 14.9-inch average. This makes the Los Angeles basin a land of extremes in terms of annual precipitation.

Annual precipitation in the cities across the region varies greatly due to the variations in mountains in the area. The Santa Monica, Santa Susana, and Verdugo Mountains that surround three sides of the valley seldom reach heights above three thousand feet. The western San Gabriel Mountains, in contrast, have elevations of more than seven thousand feet. These higher ridges often trap eastern-moving winter storms. Although downtown Los Angeles averages just fifteen inches of rain a year, some mountain peaks in the San Gabriel's receive more than forty inches of precipitation annually![3] Because San Dimas is in the southern portion of the San Gabriel Valley, there is a potential for increases in the collection of rainwater.

Monsoons

Another relatively regular source for heavy rainfall, particularly in the mountains and adjoining cities, is from summer storms. Table 8-2 lists tropical storms that have had significant rainfall in the past century, and the affected areas. These storms usually coincide with El Niño.

Table 8-2 Tropical Storms in Southern California

Date	Areas Affected	Rainfall
July 1902	Deserts & Southern Mountains	**up to 2"**
Aug. 1906	Deserts & Southern Mountains	**up to 5"**
Aug. 1921	Deserts & Southern Mountains	**up to 2"**
Sept. 1921	Deserts	**up to 4"**
Sept. 1929	Southern Mountains & Deserts	**up to 4"**
Sept. 1932	Mountains & Deserts, 15 Fatalities	**up to 7**
Aug. 1935	Southern Valleys, Mountains & Deserts	**up to 2"**
Sept. 1939	Southern Mountains, Southern & Eastern Deserts	**up to 7**

	Long Beach, W/ Sustained Winds of 50 Mph	**5"**
	Surrounding Mountains	**6 to 12"**
Sept. 1945	Central & Southern Mountains	**up to 2”**
Sept. 1946	Southern Mountains	**up to 4"**
Aug. 1951	Southern Mountains & Deserts	**2 to 5"**
Sept. 1952	Central & Southern Mountains	**up to 2"**
Jul-54	Deserts & Southern Mountains	**up to 2"**
Jul-58	Deserts & Southern Mountains	**up to 2"**
Sept. 1963	Central & Southern Mountains	**up to 7"**
Sept. 1976	Central & Southern Mountains, 3 Fatalities	**6 to 12"**
Aug. 1977	Mountains	**up to 8"**
Sept. 1978	Mountains	**3"**
Sept. 1982	Mountains	**up to 4"**
Sept. 1983	Southern Mountains & Deserts	**up to 3"**

Geography and Geology

The greater Los Angeles Basin is the product of rainstorms and erosion for millennia. Most of the mountains that frame the valleys and coastal plain are deeply fractured faults and, as they grow taller, their brittle slopes continually erode. Rivers and streams carried, rocks, gravel, sand, and silt down these slopes to the valleys and coastal plain. In places, these sediments are as much as twenty thousand feet thick.[5]

Much of the coastal plain rests on the ancient rock debris and sediment washed down from the mountains. This sediment can act as a sponge, absorbing vast quantities of rain in those years when heavy rains follow a dry period. Like a saturated sponge, the same soil fills up rapidly when a heavy rain follows a period of relatively wet weather. Even in years of heavy rain, flooding is minimal because the ground is relatively dry.

As we are well aware, the Los Angeles Basin is highly built out. This leaves little open land to absorb rainfall. The lack of open ground forces water to remain on the surface and rapidly accumulate. If not for the massive river control system lined with concrete, potential for flooding would greatly increase. In-fill building also leads to a higher risk of flooding. Developers may tear down an older home that typically covers up to 40% of the lot size and replace it with four town homes or apartments, which may cover 90-95% of a lot.

While uncommon, another potential source of flooding in San Dimas is asphalt creep. The street space between the curbs of a street is a part of the flood control system. As water leaves property and accumulates in the streets, it is directed towards the underground portion of the system. The carrying capacity of the street is determined by the width of the street and the height of the curbs along the street. Often, when streets are resurfaced, a one to two inch layer of asphalt is laid down over the existing materials, leading to a marginal reduction of capacity over time.

Flood Terminology

Floodplain

A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. This area, if left undisturbed, acts to store excess floodwater. The floodplain consists of the floodway and the flood fringe. Floodplain management is the overall program of corrective and preventative measures for reducing flood damage, including emergency preparedness plans, flood control works, and regulations.

100-Year Flood

The 100-year flooding event is the flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years. The 100-year floodplain is the area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood. Flood Zone A in Map 8-1 is the portion of the City that falls within the 100-year flood zone.

Floodway

The floodway is one of two main sections that make up the floodplain. Floodways are defined for regulatory purposes. Unlike floodplains, floodways do not reflect a recognizable geologic feature. According to the City's General Plan, floodways are defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.. Their purpose is to carry the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that they are free from development that would obstruct or divert flood flows onto other properties.

San Dimas regulations discourage development in the floodways since they are extremely hazardous areas due to the velocity of the floodwaters, which carry debris, potential projectiles, and erosion potential. Municipal Code 15.60.180 prohibits encroachments, including fill, new construction and substantial improvements, and other development unless certification by a registered professional engineer or architect is provided demonstrating that these shall not result in any increase in flood levels during the occurrence of the base flood discharge.

Development

For floodplain ordinance purposes, development is broadly defined by the City of San Dimas Floodplain Management Code to mean any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, or excavation located within the area of special flood hazard. The definition of development for floodplain purposes is generally broader and includes more activities than the definition of development used in other sections of local land use ordinances.

Base Flood Elevation (BFE)

Base Flood Elevation refers to the elevation (normally measured in feet above sea level) that the base flood is expected to reach. Base flood elevations can be set at levels other than the 100-year flood. Some communities choose to use higher frequency flood events as their base flood

elevation for certain activities, while using lower frequency events for others. For example, for the purpose of storm water management, a 25-year flood event might serve as the base flood elevation, while the 500-year flood event may serve as base flood elevation for the tie down of mobile homes. The City focuses on development in the 100-year floodplain.

Characteristics of Flooding

Four types of flooding primarily affect the City of San Dimas: riverine flooding, urban flooding, dam failure, and debris flows (see descriptions below). In addition, any low-lying area has the potential to flood. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.

Riverine Flooding
Riverine flooding is the over bank flooding of rivers and streams. The natural processes add sediment and nutrients to fertile floodplain areas. Flooding in river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing problems in hundreds of smaller streams, which then drain into major rivers.

Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas inundated by the 100-year flood with flood depths of only one to three feet. These areas generally flood with low velocity sheet flows of water.

Urban Flooding
As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly and peak with violent force. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains often back up with vegetative debris causing additional, localized flooding.

Dam Failure Flooding
Loss of life and damage to structures, roads, and utilities are products of dam failure. Economic losses can also result from a lowered tax base and lack of utility profits. These effects would certainly accompany the failure of one of the major dams in the City of San Dimas. There are two reservoirs in San Dimas, the San Dimas Reservoir and Puddingstone Reservoir, each holding millions of gallons of water. Because dam failure can have severe consequences, FEMA requires that all dam owners develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions. Although there may be coordination with county officials in the development of the EAP, the responsibility for developing potential flood inundation maps and facilitation of emergency response is the responsibility of the dam owner. Map 8-2 shows the dam inundation potential in the City.

Since the 19th century, there have been 45 dam failures in California. The following table presents the significant dam failures in Southern California.

Table 8-3 Dam Failures in Southern California[6]

1925	Sheffeld, Santa Barbara	Earthquake slide
1926	Puddingstone, Pomona	Overtopping during construction
1927	Palm Springs	Overtopping
1928	Saint Francis, San Francisquito Canyon	Sudden failure at full capacity, 426 deaths
1934	Cogswell, Monrovia	Breaching of concrete cover
1963	Baldwin Hills, Los Angeles	Leak through embankment turned into washout, 3 deaths

The two most significant dam failures are the St. Francis Dam in 1928 and the Baldwin Hills Dam in 1963. The following are accounts of the travesties, courtesy of USC archives and the *Los Angeles Times.*

The collapse of the St. Francis Dam, and the resulting loss of hundreds of lives in the path of a deluge of water, was a catastrophe that resulted in the almost complete destruction of the surround community. The dam gave way on March 12, 1928, three minutes before midnight. Its waters swept through sixty-five miles of the Santa Clara Valley toward the Pacific Ocean.

At its peak, the wall of water was 78 feet high. By the time it hit Santa Paula, 42 miles south of the dam, the water was estimated to be 25 feet deep. The flood destroyed everything in its path - livestock, structures, railways, bridges, and orchards. By the time it was over, parts of Ventura County lay buried under 70 feet of mud and debris. Over 500 people died from the catastrophe.[8]

The Baldwin Dam collapse, while not as destructive as the St. Francis Dam, sent a 50-foot wall of water down Cloverdale Avenue and slammed into homes and cars on Dec. 14, 1963. Five peo ple were killed. Sixty-five hillside houses were destroyed, and 210 homes and apartments were damaged. The flood swept northward in a V-shaped path roughly bounded by La Brea Avenue and Jefferson and La Cienega boulevards. It took only 77 minutes for the lake to empty, but it took a generation for the neighborhood below to recover. Two decades passed before the Baldwin Hills ridge top was reborn.

The cascade caused an unexpected ripple effect that echoes in Los Angeles today. It foreshadowed the end of urban-area earthen dams as a major element of the Department of Water and Power's water storage system. It also prompted a tightening of Division of Safety of Dams control over reservoirs throughout the state.[9]

Debris Flows

Other flood related hazard that can affect certain parts of the Southern California region are debris flows. Typically, debris flows occur in mountain canyons and the foothills against the San Gabriel Mountains. However, any hilly or mountainous area with intense rainfall and the proper geologic conditions may experience one of these very sudden and devastating events.

Debris flows, sometimes referred to as mudslides, mudflows, or lahars, are common types of fast-moving landslides. These flows generally occur during periods of intense rainfall or rapid snowmelt. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that can exceed 35 miles per hour. The consistency of debris-flows ranges from watery mud, to thick, rocky mud that carries large items such as boulders, trees, and cars.[10]

What is the Effect of Development on Floods?

Development raises river levels by forcing the river to compensate for the flow space obstructed by the structures. When materials are added to the floodplain and no fill is removed to compensate, serious problems can arise. This forces floodwaters out of historic floodplain areas. The City requires engineer certification to ensure that proposed developments will not adversely affect the flood carrying capacity of the Special Flood Hazard Area (SFHA). Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention should be given to development that occurs within the floodway to ensure that structures are prepared to withstand base flood events. In highly urbanized areas, increased paving can lead to an increase in volume and velocity of runoff after a rainfall event, exacerbating the potential flood hazards. The development and implementation of storm water management systems ensures these runoff waters are handled effectively.

Identifying Flood-Prone Areas

Flood maps and Flood Insurance Studies (FIS) often delineate flood prone areas. The establishment of the NFIP in 1968 was a means of providing low-cost flood insurance to the nation’s flood-prone communities. The NFIP also reduces flood losses through regulations that focus on building codes and sound floodplain management. In the City of San Dimas, the NFIP and related building code regulations went into effect in 1978. NFIP regulations (44 Code of Federal Regulations Chapter 1, Section 60, 3) require that all new construction in floodplains must be elevated at or above base flood level.

Flood Insurance Rate Maps (FIRM) and FIS Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A FIRM is the

official map produced by FEMA that delineates SFHA in communities where NFIP regulations apply. Insurance agents and mortgage lenders use FIRMs to determine if flood insurance is required and applicable rates.

Water surface elevations, combined with topographic data, develop FIRMs that illustrate areas inundated during a 100-year flood, floodway areas, as well as elevations marking the 100-year-flood level. In some cases, they also include base flood elevations (BFEs) and areas located within the 500-year floodplain. FIS and FIRMs produced for the NFIP provide assessments of the probability of flooding at a given location. FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. These studies and maps represent flood risk at the point in time when FEMA completed the studies. While not true in every region, flood maps cover 100% of the total population in the City of San Dimas.

Although helpful, FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed the studies, and does not incorporate planning for floodplain changes in the future due to new development. Although FEMA is considering changing that policy, it is optional for local communities. Manmade and natural changes to the environment have changed the dynamics of storm water run-off since then.

Flood Mapping Methods and Techniques

In order to address a lack of data, the City, as well as other jurisdictions, has taken efforts to develop more localized flood hazard maps. One method includes using high water marks from flood events or aerial photos, in conjunction with the FEMA maps to reflect the true flood risk. In other areas throughout the region, the use of GIS is becoming an important tool for flood hazard mapping. FIRM maps can be imported directly into GIS, which allows for GIS analysis of flood hazard areas.

Communities find it particularly useful to overlay flood hazard areas on tax assessment parcel maps. This allows evaluation of the flood hazard risk for a specific parcel during review of a development request. Coordination between FEMA and local planning jurisdictions is the key to making a strong connection with GIS technology for flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI) have formed a partnership to provide multi-hazard maps and information to the public via the Internet. ESRI produces GIS software. The hazards maps provided by ESRI assist communities in evaluating geographic information about natural hazards.

Hazard Assessment

Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. The intensity and overall effects of the hazard in the floodplain is estimated and mapped by using the probability of flood events. Floodplain maps provide detailed information that assists jurisdictions in making policies and land-use decisions. San Dimas adapted its flood hazard maps from FEMA.

FEMA mapped the 100-year and 500-year floodplains through the FIS in conjunction with the United States Army Corps of Engineers (USACE) in August of 1987. There were previous studies done, including a HUD study, which mapped the floodplain in June of 1978. The county has updated portions of the USACE and FEMA maps through smaller drainage studies in the county since that time.

Vulnerability Assessment

Vulnerability assessment is the second step of flood-hazard assessment. It combines the floodplain boundary, generated through hazard identification, with an inventory of the property within the floodplain. Understanding the population and property exposed to natural hazards will assist in reducing risk and preventing loss from future events. Because site-specific inventory data and inundation levels given for a particular flood event (10-year, 25-year, 50-year, 100-year, and 500-year) are not readily available, calculating a community's vulnerability to flood events is not straightforward. With all of the necessary information, the amount of property in the floodplain, as well as the type and value of structures on those properties, can be calculated to provide a working estimate for potential flood losses.

San Dimas has calculated a preliminary inventory of critical infrastructure located within Flood Zone A9. While the entire City is located within a flood zone, the probability of flooding is extremely low outside the 100-year flood plain. Only thirty residential units are located within this hazard area, not even 1% of the total housing structures. The total value of these structures is approximately $12 million.[11] While further development in the area is not currently planned, any additions will be accounted for when the NHMP is next updated.

Table 8-4 Infrastructure Assessment: Flooding

Land Use	Units in Hazard Area	Percentage in Hazard Area	Value in Hazard Area
Residential	30	0.3%	$12 million
Commercial	0	0%	$0.00
Industrial	0	0%	$0.00
Religious / Non-Profit	0	0%	$0.00
Government	0	0%	$0.00
Education	0	0%	$0.00
Utilities	NA	NA	NA
Agricultural	NA	NA	NA
Total	30	.3%	$12 million

As with the other risk assessments throughout this document, the flood assessment will be improved and updated upon final implementation of a GIS system. For a more detailed risk assessment work sheet, refer to Appendix F.

Risk Analysis

Risk analysis is the third phase of a hazard assessment. It builds upon the hazard identification

and vulnerability assessment. A flood risk analysis for the City of San Dimas should include two components. First, it estimates the life and value of property that may incur losses from a flood event (defined through the vulnerability assessment). Secondly, it includes the number and type of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The hydrological analysis of landscape features form the basis of the data used to develop these models. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that expected from a flood event.

It is possible to map the expected damage from flood events over time using flow velocity models. It is also feasible to pinpoint the effects of certain flood events on individual properties. At the time of publication of this plan, data was insufficient to conduct a risk analysis for flood events in the City of San Dimas. However, future mapping projects can produce better data that assist in understanding risk.

Community Flood Issues-What is Susceptible to Damage during a Flood?

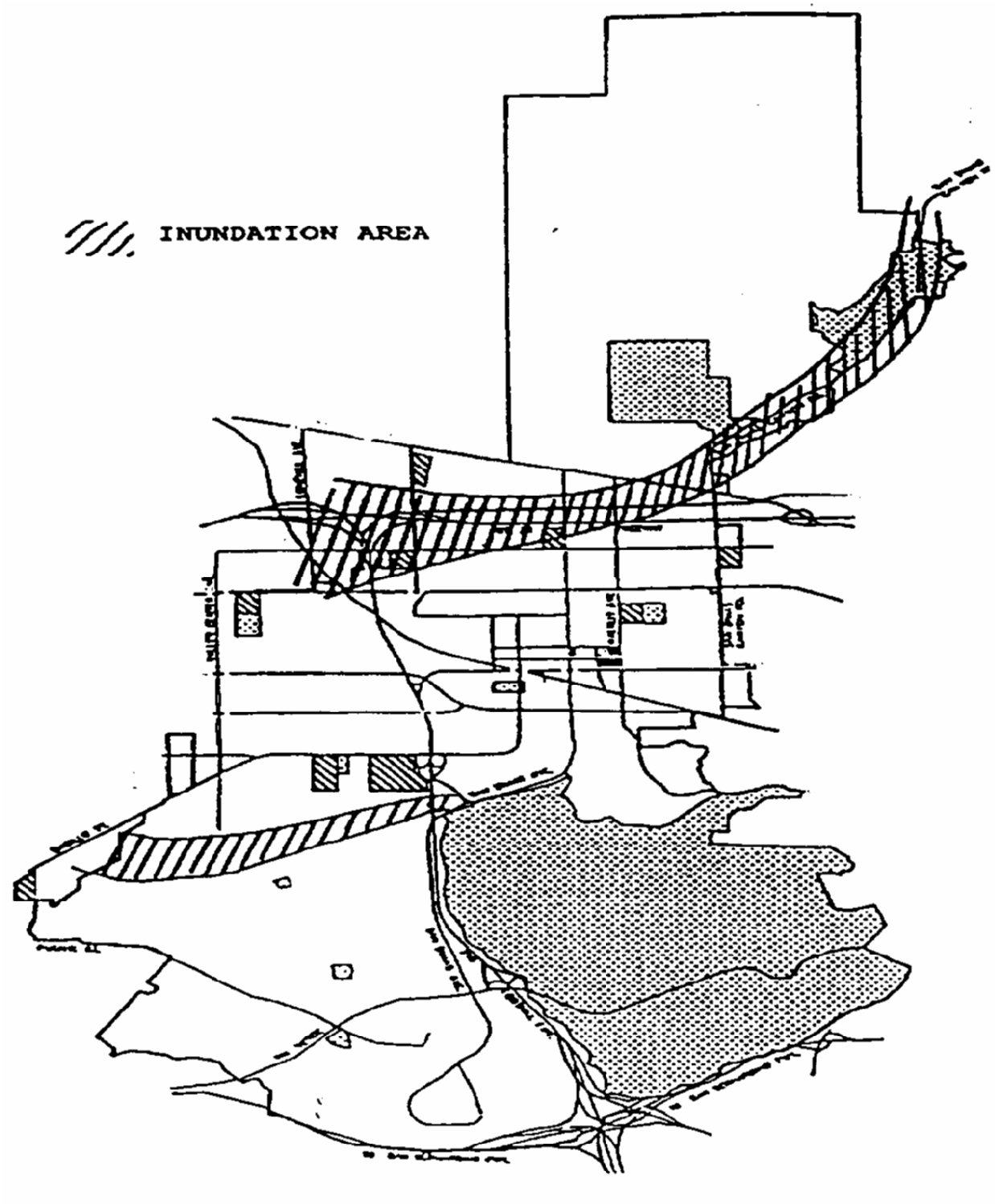
The largest impact on communities from flood events is the loss of life and property. During certain years, property losses resulting from flood damage are extensive. Development in the floodplains of San Dimas will continue to be at risk because flood damage occurs on a regular basis throughout the county. Property loss from floods strikes both private and public property.

Property Loss Resulting from Flooding Events
The type of property damage caused by flood events depends on the depth and velocity of the floodwaters. Faster moving floodwaters can wash buildings off their foundations and sweep cars downstream. High waters, combined with floating debris, strains the local infrastructure. Homes are particularly susceptible to basement flooding. Unexpected water levels destroy high saturation materials such as wood, fabric, wallboard, and insulation. In many cases, flood damage to homes renders them unlivable.

Manufactured Homes
Throughout the state of California, the 1996 floods destroyed over one hundred and fifty housing units. Of those units, sixty-one percent were mobile homes and trailers. Unfortunately, many older manufactured home parks are located in floodplain areas. Manufactured homes have a lower level of structural stability than stick-built homes, and must be anchored to provide additional structural stability during floods. Because of the confusion resulting from multiple changes in NFIP regulations in the 1980s, there are communities that do not actively enforce anchoring requirements. The lack of enforcement of manufactured home construction standards in floodplains can contribute to severe damages from flood events.

According to the City of San Dimas Planning Division, the mobile home parks listed below have some portion of their property in the 100-year floodplain. The safety of these parks and their compliance with land use planning and building codes, as well as FEMA NFIP requirements, may warrant further investigation. The following are mobile home parks located in San Dimas:

Map 8-2 Dam Inundation in San Dimas



San Dimas Royal, located on Covina Boulevard
Mobile Land, located on Covina Boulevard
Cienega Valley Estates, located on Cienega Avenue
Lone Hill Manor, located on Cypress Street
Charter Oak, located on Covina Boulevard

Business/Industry
While the majority of businesses in San Dimas are not in eminent danger from flooding, flood events have the potential to affect them by damaging property and by interrupting daily operations. These events can cut off customer access as well as close a firm for repairs. A quick response to the needs of industry affected by floods can help the community maintain economic vitality in the face of a disaster. Assistance to businesses can include funding to help owners in elevating or relocating flood-prone structures.

Public Infrastructure
Publicly owned facilities are a key component of daily life for all citizens of the City. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as constructing public policy that reduces risk to private property from flood events.

Roads
During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Federal, state, county, and City governments all have a stake in protecting roads from flood damage. Transportation agencies responsible for road maintenance are typically aware of roads at risk from flooding. Since road networks often traverse floodplain areas, these jurisdictions must coordinate operations during a natural hazard.

Bridges
Observing bridges during flood events is essential because they are important links in road networks, however, they can be obstructions inhibiting the flow of water. The bridges in San Dimas are City owned. A state-designated inspector must inspect these bridges every two years. The inspections are rigorous, looking at everything from seismic capability to erosion and scour. The seven bridges in the City of San Dimas are at the following locations:

San Dimas Avenue at the San Dimas Wash
Foothill Blvd. at the San Dimas Wash
San Dimas Canyon Road at the San Dimas Wash
Cataract Avenue at the San Dimas Wash
Via Verde CC at Monte Vista
Via Verde CC at Via Esperanza
Valley Center Ave at an unnamed wash

Storm Water Systems
Local drainage problems are common in particular sections of San Dimas, specifically near Washes and Reservoirs. A predicament arises when storm water runoff enters culverts or goes underground into storm sewers. Inadequate maintenance can also contribute to the flood hazard in urban areas. While this occurrence is rare, the City has taken numerous steps to mitigate additional damage from drainage problems.

Water/Wastewater Treatment Facilities[15]
There are twenty-five sanitary districts that' serve Los Angeles County. There are no wastewater treatment facilities directly in San Dimas, but there are ten located within LA County serving the City. The Districts operate a comprehensive solid waste management system serving the needs of a large portion of the County.

The Sanitation Districts construct, operate, and maintain facilities to collect, treat, recycle, and dispose of sewage and industrial wastes and provide for the management of solid wastes, including disposal, transfer operations, and materials recovery. Local sewers and laterals that connect to the Sanitation Districts' trunk sewer lines are the responsibility of the local jurisdictions, as is the collection of solid wastes.

The agency's 1,300 miles of main trunk sewers and eleven wastewater treatment plants convey and treat approximately 530 million gallons per day (MGD), 190 MGD of which are available for reuse in the dry Southern California climate. Three active sanitary landfills handle approximately 22,000 tons per day (TPD) of trash (approximately 40% of the countywide disposal capacity), of which 14,000 TPD are disposed and 8,000 TPD are recycled.

Water Quality[16]
The Southern California Water Company provides water to San Dimas and the surrounding area. Water delivered to customers in the San Dimas system is a blend of water from Three Valleys Municipal Water District and the Covina Irrigating Company, and ground water pumped from the Pomona, and the Main San Gabriel groundwater basins.

Drinking water, including bottle water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily mean water may be a health risk.

All ten wells sources are vulnerable to one or more possible contaminating activities, however it is important to note that contaminants associated with these activities have not been detected in the water supply: dry cleaners, above ground storage tanks, drinking water treatment plants, managed forests, transportation corridors, freeways, and state highways, high-density housing, gas stations, confirmed leaking underground storage tanks.

The Southern California Water Company routinely tests the water for substances and shows that the water meets all existing federal and state standards for safety. During flood events, these wells are subject to contamination.

Existing Flood Mitigation Activities[17]

Flood mitigation activities listed here include current mitigation programs and activities implemented by the City of San Dimas agencies or organizations.

The San Gabriel River is highly engineered for flood protection and water conservation. Approximately ten miles of the mainstream have levees and concrete bottoms, and more than 30 miles have levees and soft bottoms. LA County Department of Public Works operates three detention reservoirs and is responsible for all channel operations. The US Army Corp of Engineers maintains two large flood control structures the Santa Fe and Whittier Narrows Dams.

Like the San Gabriel River, the Los Angeles River is managed for flood control. The USACE maintains two large flood control structures in the San Fernando Valley – Hansen Dam on Tujunga Wash and Sepulveda Basin at the LA River. The LACDPW maintains all channels, except for the Glendale Narrows soft-bottom reach.

There are four major surface drainage courses in the city. They include Wildwood Canyon Wash, Sycamore Canyon Wash, San Dimas Canyon Wash, and Walnut Creek Wash. The Los Angeles County Flood Control System maintains these drainage courses. In the northern sections of the San Dimas Canyon wash, the flood control channels are not paved, but have levees with natural bottoms that eventually become paved channels.

The City of San Dimas Codes
San Dimas uses building codes, zoning codes, and various planning strategies to address the goals that aim at restricting development in areas of known hazards, and applying the appropriate safeguards. Chapter 15.60 of the City's Municipal Code addresses flood plain management. The purpose of the chapter is to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by various provisions. These provisions are designed to:

- Protect human life and health
- Minimize expenditure of public money for costly flood control projects
- Minimize the need for rescue and relief efforts associated with flooding at the expense of the public
- Minimize prolonged business interruptions
- Minimize damage to public facilities and utilities Help maintain a stable tax base by providing for the second use and development of areas of special flood hazard so as to minimize future flood blight areas
- Ensure that potential buyers are notified that property is in an areas of special flood hazard
- Ensure that those who occupy the areas of special flood hazards assume responsibility for their actions

In order to accomplish these goals, this particular chapter also includes:

- Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities
- Requiring the uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction
- Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters
- Controlling filling, grading dredging, and other development which may increase flood damage
- Preventing or regulating the construction of flood barriers which will divert floodwaters or which may increase flood hazards in other area

Specific codes dealing with the construction of developments in the floodplain include:

§ 15.60.060 Basis for establishing the areas of special flood hazard
§ 15.60.070 Compliance
§ 15.60.080 Abrogation and greater restrictions
§ 15.60.090 Interpretation
§ 15.60.110 Establishment of development permit
§ 15.60.120 Designation of floodplain administrator
§ 15.60.140 Standards of construction
§ 15.60.150 Standards for utilities
§ 15.60.160 Standards for subdivisions
§ 15.60.170 Standards for manufactured homes
§ 15.60.180 Floodways

Acquisition and Protection of Open Space in the Floodplain

Current efforts to increase public open space in the San Dimas have been paired with the need to restore and preserve natural systems that provide wildlife habitat and help to mitigate flood events. Public parks and publicly owned open spaces can provide a buffer between flood hazards and private property.

Wetlands[18]

Many floodplain and stream-associated wetlands absorb and store storm water flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices such as levees. When the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system. Wetlands are highly effective at removing nitrogen, phosphorous, heavy metals, and other pollutants from water. For this reason, artificial wetlands are often constructed for cleaning storm water runoff and for tertiary treatment (polishing) of wastewater.

The Los Angeles County Department of Public Works, Watershed Division is in its third year of devising a San Gabriel River Master Plan to address habitat restoration, preservation, recreation,

and open space conservation for the area. This proposed corridor plan will focus on areas adjacent to the mainstream, primarily outside Angeles National Forest jurisdiction. The San Gabriel Mountains Regional Conservancy is in the process of developing a Watershed Management Plan for the Upper San Gabriel River, above Whittier Narrows, including the Walnut Creek and San Jose Creek sub-watersheds.

Storm Water Systems

Water pollution from floods degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or manmade ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality. The 2001 National Pollutant Discharge Elimination System (NPDES)[19] covers an area of approximately 3,100 square miles and serves a population of about 10 million. The County of Los Angeles and 84 incorporated cities have been granted permits.

The L.A. County Storm Water Ordinance addresses provisions that apply to the discharge, deposit or disposal of any storm water and runoff to the storm drain system and receiving waters within any unincorporated area covered by the NPDES municipal storm water permit.

The Los Angeles County Municipal Storm water NPDES Permit contains a requirement for permittees to develop and implement programs for storm water management within the County of Los Angeles. The Model Programs provide guidance that permittees can follow to implement their own programs in compliance with the Permit.

Community Issues Summary

San Dimas is working to mitigate problems regarding flood issues as they arise. However, funding, time, and labor are often unavailable, which can cause problems to go temporarily unresolved. Some low-lying areas in San Dimas are more susceptible to flooding and have incurred repetitive losses. Our flood mitigation action items specifically target these areas.

While flooding is a rare occurrence in the City of San Dimas, it is important that the NHMP address the potential and risk for the hazard by capitalizing on all available data and resources. The following mitigation action items are provided as tools to minimize the community from the risks associated with flooding.

Flood Mitigation Action Items

The flood mitigation action items provide direction on specific activities that organizations and residents in the City of San Dimas can undertake to reduce risk and prevent loss from flood events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

Action Item 3.1: Mitigate private property losses due to floods.
Implementation Initiatives:

Implementation Initiative 3.1.1 Encourage residents to participate in the flood hazard insurance program.

Implementation Initiative 3.1.2 Continue to monitor brush clearance in open channels and debris basins on private property.

Implementation Initiative 3.1.3 Educate residents on the importance of proper brush clearance.

Coordinating Organizations: City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Protect life and property; Increase public awareness.

Action Item 3.2: Enhance data and mapping for flooding information within the City. Identify and map flood-prone areas.
Implementation Initiatives:

Implementation Initiative 3.2.1 Develop and implement GIS system to map flood zones.

Coordinating Organizations: City Administration Department
Time line: Short-term.
Plan Goals Addressed: Protect life and property.

Action Item 3.3: Educate the public on the dangers and mitigation of post-fire flooding.
Implementation Initiatives:

Implementation Initiative 3.3.1 Create a public education program on sandbag techniques and other flood protection measures.

Coordinating Organizations: City Public Works Department, City Administration Department
Time line: Ongoing.
Plan Goals Addressed: Increase public awareness.

Flood Resource Directory

The following resource directory lists the resources and programs that can assist county communities and organizations. The resource directory will provide contact information for local, county, regional state and federal programs that deal with natural hazards.

County Resources

Los Angeles County Public Works Department
900 S. Fremont Ave.
Alhambra, CA 91803
Ph: 626-458-5100

Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90607
Ph: 562-699-7411 x2301

State Resources

Governor's Office of Emergency Services (OES)
P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911

California Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814
Ph: 916-653-5656

California Department of Water Resources (DWR)
1416 9th Street
Sacramento, CA 95814
Ph: 916-653-6192

California Department of Conservation: Southern California Regional Office
655 S. Hope Street, #700
Los Angeles, CA 90017-2321
Ph: 213-239-0878

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)
FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance, FEMA also operates the National

Flood Insurance Program. FEMA' s mission is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.

Federal Emergency Management Agency, Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607
Ph: 510-627-7100

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

List of Flood Related Websites

This site contains a long list of flood related Internet sites from "American Heritage Rivers" to "The Weather Channel" and is a good starting point for flood information on the Internet.

Federal Emergency Management Agency
Phone: (800) 480-2520
http://www.fema.gov/nfip/related.htm

National Flood Insurance Program (NFIP)
In Southern California many cities lie within flood zones as defined in FEMA Flood Maps. The City of San Dimas is (or is not) a community within a designated flood zone. Flood insurance is available to citizens in communities that adopt and implement NFIP building standards. The standards are applied to development that occurs within a delineated floodplain, a drainage hazard area, and properties' within 250 feet of a floodplain boundary. These areas are depicted on federal Flood Insurance Rate Maps available through the county.

National Floodplain Insurance Program (NFIP)
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

The Floodplain Management Association
The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of upcoming events, a list of positions available, an index of publications available free or at nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and a catalog of Web links.

Floodplain Management Association
P.O. Box 50891
Sparks, NV 89435-0891
Ph: 775-626-6389

The Association of State Floodplain Managers
The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM Web site includes information on how to become a member, the organization's constitution and bylaws, directories of officers and committees, a publications list, information on upcoming conferences, a history of the association, and other useful information and Internet links.

The Association of State Floodplain Managers
2809 Fish Hatchery Road
Madison, WI 53713
Ph: (608) 274-0123
http://www.floods.org

National Weather Service
The National Weather Service provides flood watches, warnings, and informational statements for rivers in the City of San Dimas.

National Weather Service
520 North Elevar Street
Oxnard, CA 93030
Ph: 805-988- 6615

Office of Hydrology, National Weather Service
The National Weather Service's Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters. This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.

National Weather Service, Office of Hydrologic Development
1325 East West Highway, SSMC2
Silver Spring, MD 20910
Ph: 301-713-1658

National Resources Conservation Service (NRCS), US Department of Agriculture

NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource, or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clear debris from clogged waterways, restore vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more that one property.

National Resources Conservation Service
14th and Independence Ave., SW, Room 5105-A
Washington, DC 20250
Ph: 202-720-7246

USGS Water Resources
This web page offers current US water news; extensive current (including real-time) and historical water data; numerous fact sheets and other publications; various technical resources; descriptions of ongoing water survey programs; local water information; and connections to other sources of water information.

USGS Water Resources
6000 J Street
Placer Hall
Sacramento, CA 95819-6129
Ph: 916-278-3000

Bureau of Reclamation
The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The Bureau provides leadership and technical expertise in water resources development and in the efficient use of water through initiatives including conservation, reuse, and research. It protects the public and the environment through the adequate maintenance and appropriate operation of Reclamation's facilities and manages Reclamation's facilities to fulfill water user contracts and protect and/or enhance conditions for fish, wildlife, land, and cultural resources.

Mid Pacific Regional Office
Federal Office Building
2800 Cottage Way
Sacramento CA 95825-1898
Ph: 916- 978-5000
http://www.usbr.gov/

Army Corps of Engineers
The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. The Corps is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage, and recreation.

US Army Corps of Engineers
P.O. Box 532711
Los Angeles CA 90053- 2325
Ph: 213-452- 3921

American Public Works Association
2345 Grand Boulevard, Suite 500
Kansas City, MO 64108-2641
Ph: 816-472-6100

Publications

NFlP Community Rating System Coordinator's Manual. This informative brochure explains how the Community Rating System works and what the benefits are to communities. It explains in detail the CRS point system, and what activities communities can pursue to earn points. These points then add up to the "rating" for the community, and flood insurance premium discounts are calculated based upon that "rating " The brochure also provides a table on the percent discount realized for each rating (1-10).

NFIP Community Rating System
(800) 480-2520 or (317) 848-2898
http://www.fema.gov/nfip/crs

Floodplain Management: A Local Floodplain Administrator's Guide to the NFlP.
This document discusses floodplain processes and terminology. It contains floodplain management and mitigation strategies, as well as information on the NFIP, CRS, Community Assistance Visits, and floodplain development standards.

National Flood Insurance Program Phone:
(800) 480-2520
http://www.fema,gov/nfip/

Flood Hazard Mitigation Planning: A Community Guide, (June 1997).
Massachusetts Department of Environmental Management. This informative guide offers a 10-step process for successful flood hazard mitigation. Steps include: map hazards, determine potential damage areas, take an inventory of facilities in the flood zone, determine what is or is not being done about flooding, identify gaps in protection, brainstorm alternatives and actions, determine feasible actions, coordinate with others, prioritize actions, develop strategies for

implementation, and adopt and monitor the plan.

Massachusetts Flood Hazard Management Program Phone
(617) 626-1250
http://www.magnetstate.ma.us/dem/programs/mitigate

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February 1987), FEMA-116. This guidebook offers a table on actions that communities can take to reduce flood losses. There is information on various types of flood hazards with regard to existing mitigation efforts and options for action (policy and programs, mapping, regulatory, non-regulatory). Types of flooding which are covered include alluvial fan, areas behind levees, areas below unsafe dams, coastal flooding, flash floods, fluctuating lake level floods, ground failure triggered by earthquakes, ice jam flooding, and mudslides.

Federal Emergency Management Agency Phone:
(800) 480-2520
http://www.fema,gov

1.http://www.lalc.k12.ca.us/target/units/river/tour/hist.html
[2] http://www.lalc.k12.ca.us/target/units/river/tour/hist.html
http://www.losangelesalmanac.com/topics/History/hi01i.htm

3.Gumprecht, Blake, 1999, Johns Hopkins University Press, Baltimore, MD.

4 .Ibid
[6] http://cee.engr.ucdavis.edu/faculty/lund/dams/Dam_History_Page/Failures.htm

8 .http://www.usc.edu/isd/archives/la/scandals/st_francis_dam.html; pictures courtesy of **www.otkz.pol.pl/ disaster/baldwin/z_06.htm**

9.http://www.latimes.com/news/local/surroundings/la-me-surround11dec11,0,1754871.story?coll=la-adelphia-right-rail

10.http://www.fema.gov/rrr/talkdiz/landslide.shtm#what
[11] The value of these units was calculated using the average value of a home in San Dimas according to the 2000 Census.
[15] http://www.lacsd.org/csdinfo.htm
[16] http://www.aswater.com
[17] http://www.lasgrwc.org/WRP/Documents/GapsReport/GaprptLAC.pdf and the City of San Dimas General Plan
[18] http://www.lasgrwc.org/WRP/Documents/GapsReport/GaprptLAC.pdf
[19] Permit issued by the California Regional Water Quality Control Board (CRWQCB) under Order No. 01-182, NPDES No. CAS004001

9 Why are Wildfires a Threat to San Dimas?

For thousands of years, fires have been a natural part of the ecosystem in Southern California, but they present a substantial hazard to life and property in communities built within hillsides and mountainous areas. There is a great potential for losses due to wild land/urban interface fires in the region. According to the California Division of Forestry (CDF), there were approximately seven thousand reportable fires in California in 2003, with over one million acres burned.[1] According to CDF statistics, in the October 2003 Firestorms, over 4,800 homes were destroyed and 22 lives were lost.[2]

The City of San Dimas most recently experienced large-scale destruction during the Williams Fire in September 2002. Between September 22 and September 27, thousands of acres on the hillsides and canyons of San Dimas were destroyed.

The damage to the businesses, residences, and infrastructure in San Dimas was roughly $201,950, and $10 million to the entire San Dimas Canyon. Over 37,000 acres of wild lands were destroyed, and hundreds of homes, recreation facilities, and local canyons were at risk. In total, the fires cost $16.4 million to fight and contain.

The City sought federal assistance from the Natural Resources Conservation Services for its recovery effort including the installation of k-rails, sandbags, trash racks, debris removal, and selective channel clearing. The Federal Emergency Management Agency (FEMA) also contributed funds to the region to help fight the fires.

Following the Williams Fire, citizens of the City of San Dimas were also at risk for landslides and debris flows that often come as a result of wild fires. Fortunately, San Dimas was successful in mitigating the effects of post-fire hazards through careful and thorough planning.

Taken from Inspiration Point towards San Dimas[3]

A view of the flames through San Dimas Canyon[4]

While this fire was monumental, it was unfortunately not unique to the City's history. In 1919, a damaging fire in the mountains north of San Dimas burned for thirty days before it could be extinguished. In 1932, a packinghouse and the Santa Fe Depot were casualties of another wildfire. In September 1955, the worst fire recorded in San Dimas occurred after two weeks of

extremely hot, dry weather. This fire started south of town, and not only burned 12 homes, but also destroyed many acres of valuable watershed, 3100 citrus, and 1400 avocado trees.

The 2003 Southern California Fires

The fall of 2003 marked the most destructive wildfire season in California history. In a ten-day period, twelve separate fires raged across Southern California in Los Angeles, Riverside, San Bernardino, San Diego, and Ventura counties. The massive Cedar fire in San Diego County alone consumed of 2,800 homes and burned over a quarter of a million acres. The following map demonstrates the 2003 wild fires in Southern California.

Map 9-1 2003 Fires in Southern California

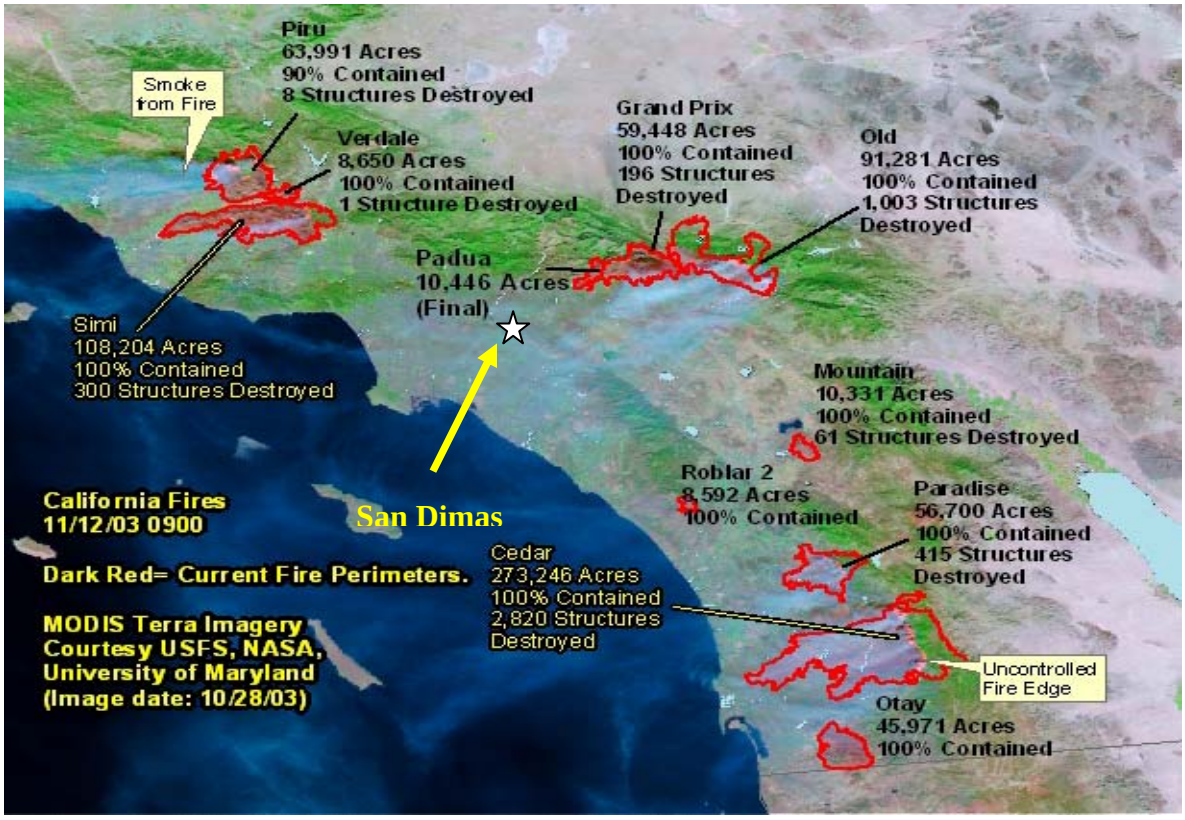


Table 9-1 2003 Firestorm Statistics

County	Fire Name	Date	Acres Burned	Homes Lost	Lives Lost
Riverside	Pass	10/21/03	2,397	3	0
Los Angeles	Padua	10/21/03	10,446	59	0
San Bernardino	Grand Prix	10/21/03	69,894	136	0
San Diego	Roblar 2	10/21/03	8,592	0	0
Ventura	Piru	10/23/03	63,991	8	0
Los Angeles	Verdale	10/24/03	8,650	1	0

Ventura	Simi	10/25/03	108,204	300	0
San Diego	Cedar	10/25/03	273,246	2,820	14
San Bernardino	Old	10/25/03	91,281	1,003	6
San Diego	Otay / Mine	10/26/03	46,000	6	0
Riverside	Mountain	10/26/03	10,000	61	0
San Diego	Paradise	10/26/03	56,700	415	2
Total Losses			**749,401**	**4,812**	**22**

Historic Fires in Southern California

Large fires have been part of the Southern California landscape for millennia. Written documents reveal that during 19th century settlement of Southern California altered coastal California by increasing the fire frequency. This was an era of very limited fire suppression, and yet like today, large crown fires covering tens of thousands of acres were not uncommon. One of the largest fires in Los Angeles County (60,000 acres) occurred in 1878, and in 1889, the greatest fire in Orange County's history, affected over half a million acres.[5]

Table 9-2 Large Historic Fires in California 1961-2003[6]

Fire Name	Date	County	Acres	Structures	Deaths
Tunnel	October 1991	Alameda	1,600	2,900	25
Cedar	October 2003	San Diego	273,246	2,820	14
Old	October 2003	San Bernardino	91,281	1,003	6
Jones	October 1999	Shasta	26,200	954	1
Paint	June 1990	Santa Barbara	4,900	641	1
Fountain	August 1992	Shasta	63,960	636	0
City of Berkeley	September 1923	Alameda	130	584	0
Bel Air	November 1961	Los Angeles	6,090	484	0
Laguna Fire	October 1993	Orange	14,437	441	0
Paradise	October 2003	San Diego	56,700	415	2
Laguna	September 1970	San Diego	175,425	382	5
Panorama	November 1980	San Bernardino	23,600	325	4
Topanga	November 1993	Los Angeles	18,000	323	3
49er	September 1988	Nevada	33,700	312	0
Simi	October 2003	Ventura	108,204	300	0
Sycamore	July 1977	Santa Barbara	805	234	0
Canyon	September 1999	Shasta	2,580	230	0
Kannan	October 1978	Los Angeles	25,385	224	0
Kinneloa	October 1993	Los Angeles	5,485	196	1
Grand Prix	October 2003	San Bernardino	59,448	196	0
Old Gulch	August 1992	Calaveras	17,386	170	0

During the 2002 fire season, more than 6.9 million acres of public and private lands burned in the United States, resulting in loss of property, damage to resources, and disruption of

community services.[7] Taxpayers spent over $1.6 billion[8] to combat more than 88,400 fires nationwide. Many of these fires burned in wild land/urban interface areas, which far exceed the fire suppression capabilities in those zones. Table 9-3 illustrates fire suppression costs for state, private, and federal lands.

Table 9-3 National Fire Suppression Costs[9]

Year	Suppression Costs	Acres Burned	Structures Burned
2000	$1.3 billion	8,422,237	861
2001	$0.5 billion	3,570,911	731
2002	$1.6 billion	6,937,584	815

Wildfire Characteristics

There are three categories of interface fire.[10] The classic wild land/urban interface fire exists where well-defined urban and suburban development presses up against open expanses of wild land areas. The second category, mixed wild land/urban interface, is characterized by isolated homes, subdivisions and small communities situated predominantly in wild land settings. The final type, occluded wild land/urban interface, exists where islands of wild land vegetation occur inside a largely urbanized area. Certain conditions must be present for significant interface fires to occur. The most common conditions include hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, several factors influence its behavior, including fuel topography, weather, drought, and development.

Southern California has two distinct areas of risk for wild land fire. The foothills and lower mountain areas are often covered with scrub brush or chaparral. In addition, the higher elevations of mountains also have heavily forested terrain. The lower elevations covered with chaparral create one type of exposure. According to Dr. Jon Keeley, USGS fire researcher, "past fire suppression is not to blame for causing large shrub wildfires, nor has it proven effective in halting them. Under Santa Ana conditions, fires carry through all chaparral regardless of age class. Therefore, prescribed burning programs over large areas to remove old stands and maintain young growth as bands of firebreaks resistant to ignition are futile at stopping these wildfires."[11]

The higher elevations of Southern California's mountains are heavily forested. The magnitude of the 2003 fires is the result of three primary factors. Severe drought, accompanied by a series of storms produced thousands of lightning strikes and windy conditions. Secondly, an infestation of bark beetles has killed thousands of mature trees. Thirdly, effects of wildfire suppression over the past century have led to buildup of brush and small diameter trees in the forests. The density of growth makes forests susceptible to disease, drought and severe. Instead of restoring forests, these wildfires destroy them and can take decades to recover. This change in our forests is the result of nearly a century of well-intentioned but misguided management.[12]

The Interface

One challenge San Dimas faces regarding the wildfire hazard is from the increasing number of houses being built on the urban/wildland interface. Every year the growing population has expanded further and further into the hills and mountains, including forest lands. The increased interface between urban/suburban areas and the open spaces created by this expansion has produced a significant increase in threats to life and property from fires and has pushed existing fire protection systems beyond original or current design and capability. Property owners in the interface are not aware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their own property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

Fuel

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is classified by volume and by type. Volume is described in terms of "fuel loading," or the amount of available vegetative fuel.

Chaparral is a primary fuel of Southern California wildfires. It can be found in elevations from near sea level to over 5,000 feet. In San Dimas, chaparral is typically located in and near the foothills. Chaparral communities experience long dry summers and receive most of their annual precipitation from winter rains. Although chaparral is often considered a single species, there are two distinct types, hard and soft chaparral. Within these two types are dozens of different plants, each with its own particular characteristics.

Fire has been important in the life cycle of chaparral communities for over 2 million years, but the true nature of the fire cycle has been subject to interpretation. In a period of 750 years, it has that fires occur roughly every 65 years in coastal drainages, and between 30 to 35 years inland.[13]

In order to protect themselves from inevitable fire damage, chaparral community plants have evolved through fire induced flowering, bud production and sprouting subsequent to fire, in-soil seed storage, fire stimulated germination; and fire stimulated dispersal.[14]

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures, and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire's ability to spread. After decades of fire suppression thickets have accumulated, which enable high intensity fires to flare and spread rapidly.

Topography

Topography influences the movement of air, thereby directing a fire course.[15] For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will also likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces up slope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable

residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

Weather

Weather patterns in certain geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible.[16] High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The Santa Ana winds, heated by compression as they flow down to Southern California from Utah, create a particularly high risk, as they can spread what might otherwise be a small fire.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term drought is a period in which an unusual scarcity of rain causes a serious hydrological imbalance. Unusually dry winters, or significantly less rainfall than normal, can lead to relatively drier conditions and leave reservoirs and water tables lower. Drought leads to problems with irrigation and may contribute to fires, or additional difficulties in fighting them.

Development

Growth and development in forested areas is increasing the number of human-made structures in Southern California interface areas.[17] Wildfire has an effect on development, yet development can also influence wildfire. Owners often prefer homes that are private, have scenic views, nestled in vegetation, and use natural materials. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and fire fighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.

Wildfire Hazard Assessment

Wildfire Hazard Identification

Wildfire hazard areas are commonly identified in regions of the wild land/urban interface. Ranges of the wildfire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control such as the surrounding fuel load, weather, topography, and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather, and topography. Table 9-4 illustrates a sample rating system used to identify wildfire hazard risk (with a score of three being the highest danger and a score of one being the least).

Table 9-4 Sample Hazard Identification Rating System

Category	Indicator	Rating
Roads and Signage	Steep; narrow; poorly signed	3
	One or two of the above	2
	Meets all requirements	1
Water Supply	None, except domestic	3
	Hydrant, tank, or pool over 500 feet away	2
	Hydrant, tank, or pool within 500 feet	1
Location of the Structure	Top of steep slope with brush/grass below	3
	Mid-slope with clearance	2
	Level with lawn, or watered groundcover	1
Exterior Construction	Combustible roofing, open eaves, Combustible siding	3
	One or two of the above	2
	Non-combustible roof, non-combustible siding	1

Vulnerability and Risk

Southern California residents are served by a variety of local fire departments as well as county, state, and federal fire resources. Data that includes the location of interface areas in the county can be used to assess the population and total value of property at risk from wildfire and direct these fire agencies in fire prevention and response. Key factors included in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence and weather, as well as occurrences of drought. The National Wildland/Urban Fire Protection Program has also developed the hazard assessment methodology for communities to assess their risk to wildfire.

In a preliminary risk assessment of the City's structures, it has been determined that approximately 14% of the City's buildings are at high risk to fire. All of these buildings are residential and lie within Fire Zone 4, which is located in and near the foothills. The net worth of these homes is approximately $555 million. Because the foothills are becoming increasingly popular, it is certain that development will increase in this hazard area. Unfortunately, itt is evident that a large fire has the potential to cause tremendous damage to the City.

Table 9-5 Infrastructure Assessment: Wildfire

Land Use	Units in Hazard Area	Percentage in Hazard Area	Value in Hazard Area
Residential	1390	15%	$555 million
Commercial	0	0	0
Industrial	0	0	0
Religious / Non-Profit	0	0	0
Government	0	0	0
Education	0	0	0
Utilities	0	0	0
Agricultural	0	0	0
Total	1390	14.3%	$555 million

Community Wildfire Issues - What is Susceptible to Wildfire?

Growth and Development in the Interface

The hills and mountainous areas of the City of San Dimas are considered interface areas. The development of homes and other structures is expanding into the wild land interface. The interface neighborhoods are characterized by a diverse mixture of housing structures, development patterns, ornamental and natural vegetation and natural fuels.

In the event of a wildfire, vegetation, structures and other flammables can merge into unwieldy and unpredictable events. Factors important to the fighting of such fires include access, firebreaks, proximity of water sources, distance from a fire station and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires shows that many structures are destroyed or damaged for one or more of the following reasons:

- Combustible roofing material
- Wood construction
- Structures with no defensible space
- Fire department with poor access to structures
- Subdivisions located in heavy natural fuel types
- Structures located on steep slopes covered with flammable vegetation
- Limited water supply
- Winds over 30 miles per hour

Road Access

Road access is a major issue for all emergency service providers. As development encroaches rural areas of the county, the number of houses without adequate turn-around space increases. In many areas, there is not adequate space for emergency vehicle turnarounds in single-family residential neighborhoods, causing emergency workers to have difficulty doing their jobs because they cannot access houses. Because fire trucks are large, firefighters are challenged by narrow roads and limited access. When there is inadequate turn around space, fire fighters can only work to remove the occupants, but cannot save the threatened structures.

Water Supply

Fire fighters in the remote and rural areas of San Dimas are faced by limited water supply and lack of hydrant taps. Rural areas are characteristically outfitted with small diameter pipe water systems, inadequate for providing sustained fire fighting flows.

Interface Fire Education Programs and Enforcement

Fire protection in interface areas may rely heavily more on the landowner's personal initiative to take measures to protect his or her own property. Therefore, public education and awareness may play a greater role in interface areas. In those areas with strict fire codes, property owners who resist maintaining the minimum brush clearances may be cited.

Continued development will have growing impacts on the wild land/urban interface. Periodically, the historical losses from wildfires in Southern California have been catastrophic, with deadly and expensive fires going back decades. The continued growth and development increases the public need for natural hazards mitigation planning in the City of San Dimas.

A firefighter in Los Angeles attempts to extinguish a burning house[18]

Existing Mitigation Activities

Local Programs

In Southern California, there are dozens of independent local fire departments as well as large county wide consolidated fire districts. Although each district or department is responsible for fire related issues in specific geographic areas, they work together to keep residents safe from fire. Although fire agencies collaborate to fight the fires, each separate agency may have a somewhat different set of codes to enforce for mitigation activities.

The fire departments and districts provide essential public services in the communities they serve and their duties far surpass extinguishing fires. Most provide other services to their jurisdictions, including Emergency Medical Services, which can begin treatment and stabilize injured patients in emergencies. All fire service providers in the county are dedicated to fire prevention and use their resources to educate the public to reduce the threat of the fire hazard, especially in the wildland/urban interface. Fire prevention professionals throughout the county have taken the lead in providing many useful and educational services to Southern California residents, such as:

- Home fire safety inspection
- Assistance developing home fire escape plans
- Business Inspections
- Citizen Emergency Response Team (CERT) training
- Counseling for juvenile fire-setters
- Teaching fire prevention in school
- Coordinating educational programs with other agencies, hospitals, and schools

The Threat of Urban Conflagration
Although communities without an urban/wildland interface are much less likely to experience a catastrophic fire, in Southern California, any community might be exposed to an urban conflagration similar to the fires that occurred following the 1906 San Francisco earthquake.

Large fires following an earthquake in an urban region are relatively rare phenomena, but have occasionally been of catastrophic proportions. The two largest peace-time urban fires in history, 1906 San Francisco and 1923 Tokyo, were both caused by earthquakes.

There has been little research concerning fire following earthquake in the United States, which is particularly surprising considering the conflagration in San Francisco after the 1906 earthquake the single largest urban fire in U.S. history. In three days, more than 28,000 buildings in a 12 kilometer area were damaged, costing about $5 billion at today's prices.[19]

Fire Codes
Local fire codes are the third tier in a hierarchical structure designed to maximize efficiency and safety. The City of San Dimas conforms to the 2001 California Fire Code (CBC), which is a direct product of the 2000 Uniform Fire Code (UBC). Because San Dimas is in a high-risk area, construction is regulated to a higher degree of care. The code demonstrates more stringent requirement for road access, width of streets, and brush clearance.

Federal Programs
The role of the federal land managing agencies is to reduce fuel hazards on the lands they administer by coordinating prevention and education programs; providing technical and financial assistance; and developing relationships with property owners, local protection agencies, states and other stakeholders. These agreements focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.

Federal Emergency Management Agency (FEMA) Programs
FEMA is directly responsible for providing Fire Suppression Assistance Grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland /urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments and provide for a greater understanding of FEMA programs at the federal, state and local levels.[20]

Fire Suppression Assistance Grants may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These state grants are provided to protect life and improved property and encourage the development and implementation of viable multi-hazard mitigation measures and provide training to clarify FEMA's programs. FEMA's US Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues and the USFA's National Fire Academy provides training programs.

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of

damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association (WGA) can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

U.S. Forest Service

The U. S. Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on forestlands. The USFS is a cooperating agency and, while it has little to no jurisdiction in the lower valleys, it has an interest in preventing fires in the interface, as fires often burn up the hills and into the higher elevation US forest lands.

Other Mitigation Programs and Activities

Some areas of the country are facing wildland/urban issues collaboratively. These model programs include local solutions. For example, in Los Angeles, the County Fire Department has retrofitted more than 100 fire engines with fire retardant foam capability. Orange County is evaluating a pilot insurance grading and rating schedule specific to the wild land/urban interface. These examples demonstrate the value of pre-suppression and prevention efforts when combined with property owner support to mitigate hazards within the wild land/urban interface.

Prescribed Burning

The health and condition of a forest will determine the magnitude of wildfire. If fuels, such as slash, and dry or dead vegetation accumulate over long periods without being methodically cleared, fire can move more quickly and destroy everything in its path. The results are more catastrophic than if the fuels are periodically eliminated. Prescribed burning is the most efficient method to get rid of these fuels. In 2003, various fire agencies conducted over 200 prescribed fires and burned over 33,000 acres to reduce the wild land fire hazard.[21]

Firewise

Firewise is a program developed within the National Wildland/ Urban Interface Fire Protection Program and it is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program empowers planners and decision makers at the local level. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the public about hazard evaluation and policy implementation techniques. Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences. The interactive home page allows users to ask fire protection experts questions and to register for new information as it becomes available.

FireFree Program

FireFree is a unique private/public program involving partnerships between an insurance company and local government agencies. Originating in Bend, Oregon, the program was developed in response to the city's Skeleton Fire of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and structures. Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort.

Wildfire Mitigation Action Items

As stated in the Federal Wildland Fire Policy, **"**The problem is not one of finding new solutions to an old problem but of implementing known solutions**.** Deferred decision making is as much a problem as the fires themselves. If history is to serve us in the resolution of the wildland/urban interface problem, we must take action on these issues now. To do anything less is to guarantee another review process in the aftermath of future catastrophic fires."[22]

The wildfire mitigation action items provide direction on specific activities that organizations and residents in San Dimas can undertake to reduce risk and prevent loss from wildfire events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

Action Item 4.1: Modify building standards to reduce fire hazards in affected residences.
Implementation Initiatives:

Implementation Initiative 4.1.1 Continue to require all new residential developments in Fire Zone 4 to go through a thorough plan check by LA County Fire and the City of San Dimas.

Implementation Initiative 4.1.2 Continue to use the design and review board to review site plan design, building materials and landscape design.

Implementation Initiative 4.1.3 Continue to enforce the use non-combustible roof materials.

Implementation Initiative 4.1.4 Continue to enforce the zoning standard requiring a minimum separation requirement for structures in Specific Plan 25.

Implementation Initiative 4.1.5 Develop guidelines for a water availability assessment to be conducted for all new developments in Specific Plan 25.

Coordinating Organizations: City Planning Department, City Public Works Department
Time line: Ongoing, Short-term.
Plan Goals Addressed: Protect life and property; Environmental and historical preservation.

Action Item 4.2: Monitor the use of vacant parcels to reduce the risk and spread of fire.
Implementation Initiatives:

Implementation Initiative 4.2.1 Identify vacant parcels with problem vegetation and weeds.

Implementation Initiative 4.2.2 Maintain vigilant weed abatement enforcement and suggest replacement of brush with non-combustible vegetation.

Implementation Initiative 4.2.3 Coordinate efforts with Cal-Trans (and other agencies) regarding landscape clearance and replacement vegetation for perimeter areas.

Implementation Initiative 4.2.4 Encourage environmentally sensitive vegetation clearance techniques in hillside areas.

Coordinating Organizations: City Planning Department, City Public Works Department
Time line: Ongoing.
Plan Goals Addressed: Strengthen partnerships; Protect life and property; Environmental and historical preservation.

Action Item 4.3: Educate residents on the importance of brush clearance and hazards of fire.
Implementation Initiatives:

Implementation Initiative 4.3.1 Coordinate efforts with the Fire Department on conducting community fire safety expos.

Implementation Initiative 4.3.2 Educate the community on the Red Flag Warning System. Suggested outreach venues include the City newsletter, website, and public access channel.

Coordinating Organizations: LA County Fire Department, Administration Department
Time line: Short-term
Plan Goals Addressed: Increase public awareness, Strengthen partnerships.

Wildfire Resource Directory

County Resources

Los Angeles County Fire Department
1320 N. Eastern Ave.
Los Angeles, CA 90063
Telephone: 323.881.2411
http://www.lacofd.org/default.htm

State Resources

California Division of Forestry & Fire Protection
1416 9th Street
PO Box 944246
Sacramento California 94244-2460
(916)653-5123
http://www.fire.ca.gov/php/index.php

Office of the State Fire Marshal (OSFM)
1131 "S" Street
PO Box 944246
Sacramento, CA 95814
Tel. (916) 445-8200

Federal Resources and Programs

Federal Wildland Fire Policy, Wildland/Urban Interface Protection
This is a report describing federal policy and interface fire. Areas of needed improvement are identified and addressed through recommended goals and actions.
<http://www.fs.fed.us/land/wdfire7c.htm>

National Fire Protection Association (NFPA)
This is the principal federal agency involved in the National Wildland/Urban Interface Fire Protection Initiative. NFPA has information on the Initiatives programs and documents.

Public Fire Protection Division
One Battery March Park.
P.O. Box 9101
Quincy, MA 02269-9101
Phone: (617) 770-3000

National Interagency Fire Center (NIFC)
The NIFC in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations. These agencies include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, Fish and Wildlife Service, National Park Service, National Weather Service and Office of Aircraft

National Interagency Fire Center
3833 S. Development Ave.
Boise, Idaho 83705
208-387-5512
http://www.nifc.gov/

United States Fire Administration (USFA) of the Federal Emergency Management Agency
As an entity of the Federal Emergency Management Agency, the mission of the USFA is to reduce life and economic losses due to fire and related emergencies through leadership, advocacy, coordination, and support.

USFA, Planning Branch, Mitigation Directorate
16825 S. Seton Ave.
Emmitsburg, MD 21727
(301) 447-1000
<http://www.fema.gov/hazards/fires/wildfires.shtm>

Additional Resources
Firewise - The National Wildland/Urban Interface Fire Program
Firewise maintains a Website designed for people who live in wildfire prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.

Firewise
One Battery March Park.
P.O. Box 9101
Quincy, MA 02269-9101
Phone: (617) 770-3000
http://www.firewise.org/

Publications
National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire, National Wildland/Urban Interface Fire Protection Program, (1991), National Fire Protection Association, Washington, D. This document, developed by the NFPA Forest and Rural Fire Protection Committee, provides criteria for fire agencies, land use planners, architects, developers and local governments to use in the development of areas that threatened by wildfire.

National Fire Protection Association Publications
http://www.nfpa.org or http://www.firewise.org

An International Collection of Wildland- Urban Interface Resource Materials (Information Report NOR- 344). Hirsch, K., Pinedo, M., & Greenlee, J. (1996). Edmonton, Alberta: Canadian Forest Service. This is a comprehensive bibliography of interface wildfire materials. Over 2,000 resources are included, grouped under the categories of general and technical reports, newspaper articles and public education materials.

Canadian Forest Service, Northern Forestry Centre, I-Zone Series
Phone: (780) 435-7210
http://www.prefire.ucfpl.ucop.edu/uwibib.htm

Wildland/Urban Interface Fire Hazard Assessment Methodology. National Wildland/Urban Interface Fire Protection Program, (1998). NFPA, Washington, D.C.

Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility. National Wildland/Urban Interface Fire Protection Program, (1998). Washington, D.C.

---

1 http://www.fire.ca.gov/php/2003fireseasonstats_v2.asp

2 http://www.fire.ca.gov/php/fire_er_content/downloads/2003LargeFires.pdf

3 http://www.wrightwoodcalif.com

4 http://geology.csupomona.edu/janourse/Fires/SanDimasCynFire23Sept02.jpg

5 http://www.usgs.gov/public/press/public_affairs/press_releases/pr1805m.html

6 http://www.fire.ca.gov/FireEmergencyResponse/HistoricalStatistics/PDF/20LSTRUCTURES.pdf

7 http://www.nifc.gov/stats/wildlandfirestats.html

8 http://research.yale.edu/gisf/assets/pdf/ppf/wildfire_report.pdf

9 http://research.yale.edu/gisf/assets/pdf/ppf/wildfire_report.pdf

10 Planning for Natural Hazards: The Oregon Technical Resource Guide, (July 2000) Department of Land Conservation and Development

11 http://www.usgs.gov/public/press/public_affairs/press_releases/pr1805m.html

12 Overgrown Forests Require Preventive Measures, By Gale A. Norton (Secretary of the Interior), USA Today Editorial, August 21, 2002

13 http://www.coastal.ca.gov/fire/ucsbfire.html

14 Ibid

15 http://www.esri.com/news/arcnews/winter0304articles/winter0304gifs/p20p1-lg

16 Planning for Natural Hazards: The Oregon Technical Resource Guide, (July 2000), Department of Land Conservation and Development

17 picture courtesy of **www.disasterrelief.org/ Disasters/990901Fires/**

18 **www.argusleader.com/. ../page2.shtml**

19 http://www.eqe.com/publications/revf93/firefoll.htm

20 Source: National Interagency Fire Center, Boise ID and California Division of Forestry, Riverside Fire Lab.

21 LA County Fire Department.

22 http://www.fs.fed.us/land/wdfire7c.htm

10 Why are Windstorms a Threat to the City of San Dimas?

Severe windstorms pose a significant risk to life and property in the region by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. High winds can occasionally cause tornado-like damage to local homes and businesses. These storms can present a very destabilizing effect on the dry brush that covers local hillsides and urban wild land interface areas.

Windstorm Characteristics in Southern California

Santa Ana Winds and Tornado-Like Wind Activity

Based on local history, most incidents of high wind in the City are the result of the Santa Ana wind conditions. While high impact incidents are not frequent in the area, significant Santa Ana Wind events have been known to negatively affect San Dimas and the local community.

Santa Ana winds are defined as warm, dry winds that blow from the east or northeast. These winds occur below the passes and canyons of the coastal ranges of Southern California and in the Los Angeles basin and often blow with exceptional speed in the Santa Ana Canyon. Forecasters at the National Weather Service offices usually reserve the use of Santa Ana winds for those greater than 25 knots.[1] These winds accelerate to speeds of 35 knots as they move through canyons and passes, with gusts to 50 or 60 knots.

The complex topography of the region along with various atmospheric conditions can create scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Mountains and west of the Rocky Mountains). Clockwise circulation around the center of this high pressure area forces air down slope from the high plateau. The air warms as it descends toward the California coast due to compressional heating.[2]

These regional winds typically occur from October to March, and are named either for the Santa Ana River Valley where they originate or for the Santa Ana Canyon, where they pick up speed.

Unlike the Santa Ana Winds, tornadoes are spawned when there is warm, moist air near the ground, cool air aloft, and winds that speed up and change direction. Obstructions in the path of the tornado cause it to change direction. This increases pressure on parts of the house, and the combination of pressure and fluctuating wind speeds creates stress that lead to structural failures. The Fujita Tornado Damage Scale was developed in order to measure the intensity and wind

strength of a tornado. This scale compares the estimated wind velocity with the corresponding amount of suspected damage. The scale measures six classifications of tornadoes with increasing magnitude from an F0 tornado to a F6+ tornado.

Table 10-1 Fujita Tornado Damage Scale[3]

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	**Light damage.** Some damage to chimneys and TV antennas; breaks twigs off trees; pushes over shallow-rooted trees.
F1	73-112	**Moderate damage.** Peels surface off roofs; windows broken; light trailer houses pushed or overturned; some trees uprooted or snapped; moving automobiles pushed off the road. 74 mph is the beginning of hurricane wind speed.
F2	113-157	**Considerable damage.** Roofs torn off frame houses leaving strong upright walls; weak buildings in rural areas demolished; trailer houses destroyed; large trees snapped or uprooted; railroad boxcars pushed over; light object missiles generated; cars blown off highway.
F3	158-206	**Severe damage.** Roofs and some walls torn off frame houses; some rural buildings completely demolished; trains overturned; steel-framed hangar- warehouse- type structures torn; cars lifted off the ground; most trees in a forest uprooted or snapped.
F4	207-260	**Devastating damage.** Whole frame houses leveled, leaving piles of debris; steel structures badly damaged; trees debarked by small flying debris; cars and trains thrown or rolled considerable distances; large missiles generated.
F5	261-318	**Incredible damage.** Whole frame houses tossed off foundations; steel-reinforced concrete structures badly damaged; automobile-sized missiles generated; trees debarked; incredible phenomena can occur.
F6-F12	319 to sonic	**Inconceivable damage.** Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as automobiles will create serious secondary damage.

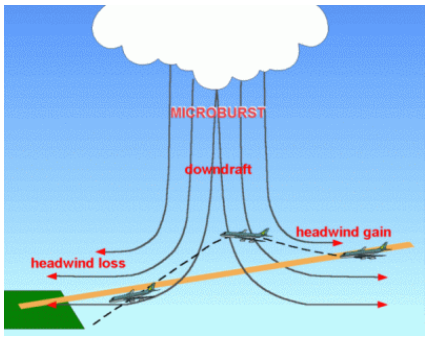
Unlike tornados, microbursts are strong, damaging winds that strike the ground and give the impression a tornado has struck. Usually, the origin of a microburst is downward moving air from a thunderstorm's core. Again, unlike a tornado, they affect only a rather small area.

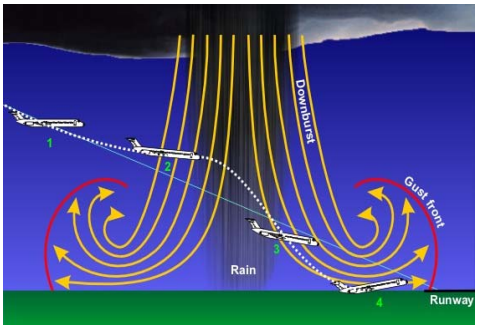
A downburst is a straight-direction surface wind in excess of 39 mph caused by a small-scale, strong downdraft from the base of convective thundershowers and thunderstorms. University of Chicago storm researchers first coined the term downburst to describe strong, downdraft winds flowing out of a thunderstorm cell that he believed were responsible for the crash of Eastern Airlines Flight 66 in June of 1975.[4] In later investigations into the phenomena he defined two sub-categories of downbursts: the larger macrobursts and small microbursts.[5]

Macrobursts are downbursts with winds up to 117 mph which spread across a path greater than 2.5 miles wide at the surface and which last from five to thirty minutes. The microburst, on the other hand is confined to an even smaller area, less than 2.5 miles in diameter from the initial point of downdraft impact. An intense microburst can result in damaging winds near 170 mph

but often lasts for less than five minutes.[6]

Downbursts descend from the upper regions of severe thunderstorms when the air accelerates downward through either exceptionally strong evaporative cooling or by very heavy. When the rapidly descending air strikes the ground, it spreads outward in all directions. After striking the ground, the powerful outward running gust can cause further problems along its path. Damage patterns away from the impact area are typically more characteristic of straight-line winds rather than the twisted pattern of tornado damage. When a microburst wind hits an object such as a house or tree, it can flatten buildings and strip branches from trees.[7] Luckily, tornados, like those that occur every year in the Midwest and Southeast parts of the United States, are a rare phenomenon in most of California, with most tornado-like activity coming from micro-bursts.[8]





Local History of Windstorm Events

While the effects of Santa Ana Winds are often overlooked, it should be noted that in 2003, two deaths in Southern California were directly related to the fierce conditions. A falling tree struck one woman in San Diego.[9] The second death occurred when a passenger in a vehicle was hit by a flying pickup truck cover launched by the Santa Ana Winds.[10] The following is a glimpse of some major Santa Ana wind/windstorm events to hit the local area:

Table 10-2 Major Windstorms / Santa Ana Wind Events 1961 - 2001[11]

Date	Location and Damage
November 6, 1961	Santa Ana winds lead to the spread of a fire in Topanga Canyon
February 11, 1973	Strong storm winds: 57 mph at Riverside, 200 trees uprooted
October 27, 1993	Santa Ana winds lead to the spread of a fire in Laguna Hills
October 14, 1997	Santa Ana winds had gusts up to 87 mph in central Orange County.
December 29, 1997	Gusts 60+ mph at Santa Ana
March 28-29, 1998	Strong storm winds in Orange County sustained 30-40 mph. Gusts of 70 mph at Newport Beach and Huntington Beach. One immigrant died.
September 2, 1998	Strong winds from thunderstorms with gusts to 40mph
December 22, 1999	Santa Ana winds: gust 68 mph at Campo, 53 Huntington Beach, 44 Orange. House and tree damage in Hemet.

March 5, 2000	Strong thunderstorm winds at the coast: gust 60 mph at Huntington Beach Property damage and trees downed along the coast
April 1, 2000	Santa Ana winds: gust 93 mph at Mission Viejo, 67 Anaheim Hills
December 25, 2000	Santa Ana winds: gust 87 mph at Fremont Canyon. Damage and injuries in Mira Loma, Orange and Riverside Counties
February 13, 2001	Thunderstorm gust to 89 mph in east Orange

The following is a brief look at major tornado-like events to hit the surrounding areas.

Table 10-3 Major Tornado-like Events in the Region 1958-2001[12]

Date	Location and Damage
April 1, 1958	Tornado: Laguna Beach
February 19, 1962	Tornado: Irvine
March 16, 1977	Tornado: Fullerton. Damage to 80 homes and injured four people
February 9, 1978	Tornado: Irvine. Property damage and 6 injured
January 31, 1979	Tornado Santa Ana Numerous power outages
November 9, 1982	Tornadoes in Garden Grove and Mission Viejo. Property damage
January 13, 1984	Tornado: Huntington Beach. Property damage
March 16, 1986	Tornado: Anaheim. Property damage
February 22-24, 1987	Tornadoes and waterspouts: Huntington Beach
January 18, 1988	Tornadoes: Mission Viejo and San Clemente. Property damage
February 28, 1991	Tornado: Tustin
December 7, 1992	Tornadoes: Anaheim and Westminster Property damage
January 18, 1993	Tornado: Orange County Property damage
February 8, 1993	Tornado: Brea. Property damage
February 7, 1994	Tornado from Newport Beach to Tustin
December 13, 1994	Two waterspouts about 0.5 mile off Newport Beach
December 13, 1995	Funnel cloud near Fullerton Airport
March 13, 1996	Funnel cloud in Irvine
November 1997	Waterspout came ashore at Newport Pier. Winds estimated at 60-70 mph. Ten cars were thrown a few feet.
December 21, 1997	Waterspout and tornado in Huntington Beach.
February 24, 1998	Tornado in Huntington Beach.
March 13-14, 1998	Numerous waterspouts between Long Beach and Catalina
April 1, 1998	Numerous funnel clouds reported off Orange County.

June 6, 1998	Two funnel clouds off Dana Point
December 31, 1998	Funnel clouds in Santa Ana. Waterspout off Costa Mesa coast
February 21, 2000	Tornado: Anaheim Hills. Property damage
October 28, 2000	Funnel clouds around Newport Beach and Costa Mesa
January 10, 2001	Funnel cloud at Orange County airport and Newport Beach
February 24, 2001	Tornado in Orange. Damage to warehouse.

Windstorm Hazard Assessment

Hazard Identification

A windstorm event in the region can range from short term microburst activity lasting only minutes to a long duration Santa Ana wind condition that can last for several days as in the case of the January 2003 Santa Ana wind event. Windstorms in San Dimas area can cause extensive damage to trees, road and highway infrastructure, and critical utility facilities.

The map shows clearly the direction of the Santa Ana winds as they travel from the stable, high-pressure weather system called the Great Basin High through the canyons and towards the low-pressure system off the Pacific. Clearly, the area of the City of San Dimas is in the direct path of the ocean-bound Santa Ana winds.

Vulnerability and Risk

With the above analysis of the high wind and tornado events depicted in the local history section, we can deduce the general windstorm impact areas including affects on life, property, utilities, infrastructure, and transportation. The following sections describes the possible consequences of a damaging windstorm in San Dimas.

Community Windstorm Issues-What is Susceptible to Windstorms?

Life and Property

Based on the history of the region, windstorm events can be expected, perhaps annually, across widespread areas of the region, which can be adversely impacted during a windstorm event. This can result in the involvement of City of San Dimas emergency response personnel during a wide-ranging windstorm or microburst tornado activity. Both residential and commercial structures with weak reinforcement are susceptible to damage. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail causing considerable damage. There have been numerous reports of downed trees in the City after such windstorms. Serious damage occurred in 2001 when a windstorm caused a street light lamp that was loosened

by severe winds to fall and strike and kill a pedestrian.

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls. When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery. The Beaufort Scale helps predict the damage these extreme winds can cause.

Table 10-4 Beaufort Scale [13]

Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air ripples look like scales; No crests of foam
2	4-7	Light Breeze - Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper
5	19-24	Fresh Breeze - Moderate, long waves; Some spray - Small trees begin to move
6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted; Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide medium sized ships; Edges of wave crests blown into froth; Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent

Utilities

Historically, falling trees have been the major cause of power outages in San Dimas. Toppling

trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Microbursts and Santa Ana Wind conditions can often cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. Overhead power lines can be damaged even in relatively minor windstorm events. Rising population growth and new infrastructure in the region creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

Infrastructure
Windstorms can damage buildings, power lines, and other property and infrastructure due to collapsed trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds. Windstorms can further result in damaged buildings, blocked roads and bridges, or broken traffic signals and streetlights.

Roads blocked by fallen trees may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.

Industry and commerce can also suffer losses from disruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Increased Fire Threat
Perhaps the greatest danger from windstorm activity in the City of San Dimas comes from the combination of the Santa Ana winds with the major fires that occur every few years. With the Santa Ana winds driving the flames, the speed and reach of the flames is even greater than in times of calm wind conditions. The higher fire hazard raised by this condition requires that even more care and attention be paid to proper brush clearances on property in the wildland/urban interface areas.

The Santa Ana Winds fuel a fire in San Diego[14]

Transportation
Windstorm activity can have an impact on local transportation, in addition to the problems caused by downed trees and electrical wires blocking streets and highways. During periods of extremely strong Santa Ana winds, major highways may be closed to truck and recreational vehicle traffic. Typically, these disruptions are not long, nor do they carry a severe long term economic impact on the region.

Estimating Potential Losses

Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. The City has calculated a preliminary inventory of vulnerable structures, as well as their values.

As evident from the chart below, there are 3265 structures in the windstorm hazard area, 99% of which are residential. These structures are primarily located in the foothills and in the town core. These 3265 structures are estimated to be worth $1.33 billion.[15] The implementation of GIS will aid the City in identifying all affected existing and new structures within the hazard area. Exact data on future development within the hazard zone is not yet available, but will be added upon subsequent updates of the Plan. For a more detailed worksheet outlining existing vulnerable infrastructure in this hazard area, please consult Appendix F.

Table 10-5 Infrastructure Assessment: Windstorms

Land Use	Units in Hazard Area	Percentage in Hazard Area	Value in Hazard Area
Residential	3245	35%	$1.3 billion
Commercial	13	5%	$15.8 million
Industrial	6	5%	9.45 million
Religious / Non-Profit	1	10%	$1.8 million
Government	0	0%	$0.00
Education	0	0%	$0.00
Utilities	NA	NA	NA
Agricultural	NA	NA	NA
Total	3265	NA	$1.33 billion

Existing Windstorm Mitigation Activities

As mentioned above, one of the most common problems associated with windstorms is power outage. High winds commonly occur during winter storms can cause trees to bend, sag, or fail, and come into contact with nearby distribution power lines. This can result in short-circuiting and conductor overloading. Wind-induced damage to the power system causes power outages to customers, incurs costs, and in some cases can lead to ignitions that start wild fires.

One of the strongest and most widespread existing mitigation strategies pertains to tree clearance. Currently, California State Law requires utility companies to maintain specific clearances (depending on the type of voltage running through the line) between electric power lines and all vegetation. The following is a list from the California Public Resource Code Sections and provides guidance on tree pruning regulations:[16]

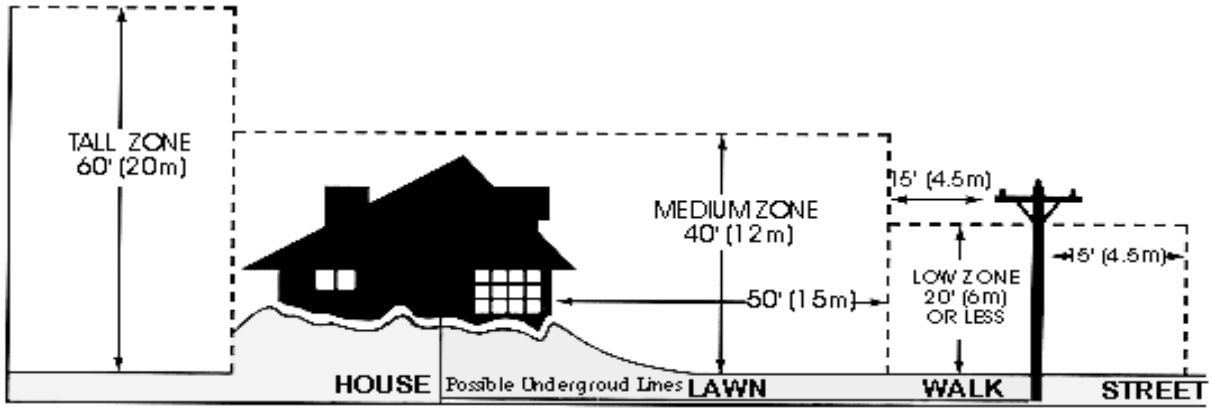
- 4293: Power Line Clearance Required
- 4292: Power Line Hazard Reduction
- 4291: Reduction of Fire Hazards around Buildings

- 4171: Public Nuisances

The following tree pruning regulations and are from the California Code of Regulations:

- Title 14, Sections 1250-1258 Minimum Clearance Provisions
- Title 8: Group 3: Articles 12, 13, 36, 37, 38
  California Penal Code Section 385
  General Industry Safety Orders

Finally, the following California Public Utilities Commission section has additional guidance under General Order 95: Rule 35.



Homeowner Liability
Failure to allow a utility company to comply with the law can result in liability to the homeowner for damages or injuries resulting from a vegetation hazard. Many insurance companies do not cover these types of damages if the policy owner has refused to allow the hazard to be eliminated.

The power companies, in compliance with the above regulations, collect data about tree failures and their impact on power lines. This mitigation strategy assists the power company in preventing future tree failure. From the collection of this data, the power company can advise residents as to the most appropriate vegetative planting and pruning procedures.

Windstorm Mitigation Action Items

The windstorm mitigation action items provide direction on specific activities that the City of San Dimas can undertake to reduce risk and prevent loss from windstorm events. Each action item is followed by ideas for implementation, which can be used by the Hazard Mitigation Planning Committees and local decision makers in pursuing strategies for implementation.

Action Item 5.1: Educate the community on the dangers of windstorms and potential mitigation measures.

Implementation Initiatives:

Implementation Idea 5.1.1 Offer pruning and tree trimming education to residents.

Implementation Idea 5.1.2 Educate the community on voluntary upgrades to structures subject to wind damage. Place particular emphasis on mobile home park residents.

Coordinating Organizations: City Parks and Recreation, City Public Works
Time line: Short-term.
Plan Goals Addressed: Increase public awareness.

Action Item 5.2: Develop and implement programs to minimize the potential for city trees from threatening lives, property, and public infrastructure during windstorm events.
Implementation Initiatives:

Implementation Initiative 5.2.1 Develop a citywide tree inventory and maintenance monitoring system.

Implementation Initiative 5.2.2 Review tree-trimming frequency and practices for City trees.

Implementation Initiative 5.2.3 Develop a policy to evaluate the health of trees for possible proactive removal. Contract professional arborists to develop policies.

Coordinating Organizations: City Parks and Recreation Department
Time line: Short-term.
Plan Goals Addressed: Protect life and property.

Action Item 5.3: Reduce the danger of structural damage to buildings along the Bonita Corridor
Implementation Initiatives:

Implementation Initiative 5.3.1 Evaluate the integrity of the facades of the buildings along the Bonita Corridor.

Implementation Initiative 5.3.2 Develop an Action Plan to encourage upgrades to sub-standard facades along the Bonita Corridor.

Coordinating Organizations: City Public Works Department, City Planning Department
Time line: Long-term.
Plan Goals Addressed: Protect life and property.

Windstorm Resource Directory

California Division of Forestry & Fire Protection
1416 9th Street
PO Box 944246
Sacramento California 94244
916-653-5123
http://www.fire.ca.gov/php/index.php

National Weather Service - Los Angeles/Oxnard Weather Forecast Office
520 North Elevar Street
Oxnard, CA 93030
805-988-6610
http://weather.noaa.gov/

International Society of Arboriculture
P.O. Box 3129
Champaign, IL 61826-3129
217.355.9411
http://www.isa-arbor.com

Protect Your Family and Property from the Hazards of Violent Windstorms http://emd.wa.gov/5-prep/trng/pubed/Windstrm.pdf

---

1 http://nimbo.wrh.noaa.gov/Sandiego/snawind.html

2 Ibid

3 http://weather.latimes.com/tornadoFAQ.asp

4 Keith C. Heidorn at http://www.suite101.com/article.cfm/13646/100918, June 1, 2003

5 Ibid

6 Ibid

7 Ibid

8 picture courtesy of **www.weather.gov.hk/.../ cause/microburst_e.htm**

9 www.cbsnews.com, January 8, 2003

10 www.cbsnews.com/stories/2003/01/06/national/

11 http://www.wrh.noaa.gov/sandiego/research/Guide/weatherhistory.pdf

12 http://www.wrh.noaa.gov/sandiego/research/Guide/weatherhistory.pdf

13 http://www.compuweather.com/decoder-charts.html

14 http://www.signonsandiego.com/news/fires/images/031027suburbs.jpg&imgrefurl

15 This value was calculated using average structure values from the 2000 Census.

16 www.cpuc.ca.gov/js.asp

Appendix A
Master Resource Directory

The Resource Directory provides contact information for local, regional, state, and federal programs that are currently involved in hazard mitigation activities. The Hazard Mitigation Technical Committee will look to these organizations for resources and assistance. The Directory provides a foundation for potential partners in action item implementation.

The Hazard Mitigation Advisory Committee will continue to add contact information for organizations currently engaged in hazard mitigation activities. This section may also be used by various community members interested in hazard mitigation information and projects.

National and Federal Resources

American Public Works Association http://www.apwa.net
The American Public Works Association is an international educational and professional association of public agencies, private sector companies, and individuals dedicated to providing high quality public works goods and services.

2345 Grand Boulevard, Suite 500
Kansas City, MO 64108-2641
Ph: 816-472-6100

Association of State Floodplain Managers http://www.floods.org
The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery.

2809 Fish Hatchery Road
Madison, WI 53713
Ph: 608-274-0123

Building Seismic Safety Council (BSSC) http://www.bssconline.org
The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

1090 Vermont Ave., NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800

Federal Emergency Management Agency, Region IX http://www.fema.gov
FEMA responds to and plans for the recovering of and mitigation of disasters.

1111 Broadway, Suite 1200
Oakland, CA 94607
Ph: 510-627-7100

Federal Emergency Management Agency, Mitigation Division
http://www.fema.gov/fima/planhowto.shtm
The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens protection, flood insurance, prevention, mitigation measures, and partnerships with communities throughout the country.

500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

Floodplain Management Association http://www.floodplain.org
The Floodplain Management Association is a nonprofit educational association. It was established in 1990 to promote the reduction of flood losses and to encourage the protection and enhancement of natural floodplain values. Members include representatives of federal, state and local government agencies as well as private firms.

P.O. Box 50891
Sparks, NV 89435-0891
Ph: 775-626-6389

Landslide Hazards Program, USGS http://landslides.usgs.gov/index.html
The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.

12201 Sunrise Valley Drive
Reston, VA 20192
Ph: 703-648- 4000

National Wildland/Urban Interface Fire Program http://www.firewise.org/
Firewise maintains a Website designed for people who live in wildfire- prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.

1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000

National Resources Conservation Service http://www.nrcs.usda.gov/
NRCS assists owners of America's private land with conserving their soil, water, and other natural resources, by delivering technical assistance based on sound science and suited to a customer's specific needs. Cost shares and financial incentives are available in some cases.

14th and Independence Ave., SW

Room 5105-A
Washington, DC 20250
Ph: 202-720-7246

National Interagency Fire Center (NIFC) http://www.nifc.gov
The NIFC in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations.

3833 S. Development Ave.
Boise, Idaho 83705-5354
Ph: 208-387- 5512

National Fire Protection Association (NFPA) - http://www.nfpa.org
The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training and education

One Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000

National Floodplain Insurance Program (NFIP) - http://www.fema.gov/nfip
The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.

500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

National Oceanic /Atmospheric Administration - http://www.noaa.gov
NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

14th Street & Constitution Ave NW
Room 6013
Washington, DC 20230
Ph: 202-482-6090

National Weather Service, Office of Hydrologic Development - http://www.nws.noaa.gov/
The Office of Hydrologic Development (OHD) enhances National Weather Service products by: infusing new hydrologic science, developing hydrologic techniques for operational use, managing hydrologic development by NWS field office, providing advanced hydrologic products to meet needs identified by NWS customers.

1325 East West Highway
SSMC2
Silver Spring, MD 20910
Ph: 301-713-1658

National Weather Service - http://www.nws.noaa.gov/
The National Weather Service is responsible for providing weather service to the nation. It is charged with the responsibility of observing and reporting the weather and with issuing forecasts and warnings of weather and floods in the interest of national safety and economy. The main priorities for service are the protection of life and property, and the promotion of the nation's welfare and economy.

520 North Elevar Street
Oxnard, CA 93030
Ph: 805-988- 6615

The Community Rating System (CRS) - http://www.fema.gov/nfip/crs.shtm
The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within the County would receive reduced NFIP flood insurance premiums if the County implements floodplain management practices that qualify it for a CRS rating. For further information on the CRS, visit FEMA's website.

500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

United States Geological Survey - http://www.usgs.gov/
The USGS provides reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

345 Middlefield Road
Menlo Park, CA 94025
Ph: 650-853-8300

US Army Corps of Engineers - http://www.usace.army.mil
The United States Army Corps of Engineers work in engineering and environmental matters. A workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals provide engineering services to the nation including planning, designing, building, and operating water resources and other civil works projects.

P.O. Box 532711
Los Angeles, CA 90053- 2325
Ph: 213-452- 3921

United States Census Bureau - http://www.census.gov
The Census Bureau provides vital information on population, demographics, unemployment, and other social statistics throughout the United States.

U.S. Census Bureau
4700 Silver Hill Road
Washington DC 20233-0001

USDA Forest Service - http://www.fs.fed.us
The Forest Service is an agency of the U.S. Department of Agriculture. The Forest Service manages public lands in national forests and grasslands.

1400 Independence Ave. SW
Washington, D.C. 20250-0002
Ph: 202-205-8333

USGS Water Resources - http://www.water.usgs.gov
The USGS Water Resources mission is to provide water information that benefits the Nation's citizens: publications, data, maps, and applications software.

6000 J Street Placer Hall
Sacramento, CA 95819-6129
Ph: 916-278-3000

Regional and County Resources

EPA, Region 9 - http://www.epa.gov/region09
The mission of the U.S. Environmental Protection Agency is to protect human health and to safeguard the natural environment through the themes of air and global climate change, water, land, communities and ecosystems, and compliance and environmental stewardship.

75 Hawthorne Street
San Francisco, CA 94105
Ph: 415-947-8000

Gateway Cities Partnership - http://www.gatewaycities.org
Notes: Gateway Cities Partnership is a 501 C 3 non-profit Community Development Corporation for the Gateway Cities region of southeast LA County. The region comprises 27 cities that roughly speaking extends from Montebello on the north to Long Beach on the South, the Alameda Corridor on the west to the Orange County line on the east.

7300 Alondra Boulevard
Suite 202
Paramount, CA 90723
Ph: 562-817-0820

Greater Antelope Valley Economic Alliance
The Greater Antelope Valley Economic Alliance, (GA VEA) is a 501 (c)(6) nonprofit organization with a 501(c)(3) affiliated organization the Antelope Valley Economic Research and Education Foundation. GA VEA is a public-private partnership of business, local governments, education, non-profit organizations and health care organizations that was founded in 1999 with the goal of attracting good paying jobs to the Antelope Valley in order to build a sustainable economy.

42060 N. Tenth Street West
Lancaster, CA 93534
Ph: 661-945-2741

Los Angeles County Economic Development Corporation - http://www.laedc.org
The LAEDC is a private, non-profit 501 (c) 3 organization established in 1981 with the mission to attract, retain, and grow businesses and jobs in the Los Angeles region. The LAEDC is widely relied upon for its Southern California Economic Forecasts and Industry Trend Reports. Lead by the renowned Jack Kyser (Sr. Vice President, Chief Economist) his team of researchers produces numerous publications to help business, media, and government navigate the LA region's diverse economy.

444 S. Flower Street
34th Floor
Los Angeles, CA 90071
Ph: 213-236-4813

Los Angeles County Public Works Department - http://ladpw.org
The Los Angeles County Department of Public Works protects property and promotes public safety through Flood Control, Water Conservation, Road Maintenance, Bridges, Buses and Bicycle Trails, Building and Safety, Land Development, Waterworks, Sewers, Engineering, Capital Projects and Airports.

900 S. Fremont Ave.
Alhambra, CA 91803
Ph: 626-458-5100

San Gabriel Valley Economic Partnership - http://www.valleynet.org
The San Gabriel Valley Economic Partnership is a non-profit corporation representing both public and private sectors. The Partnership is the exclusive source for San Gabriel Valley-specific information, expertise, consulting, products, services, and events. It is the single organization in the Valley with the mission to sustain and build the regional economy for the mutual benefit of all thirty cities, chambers of commerce, academic institutions, businesses, and residents.

4900 Rivergrade Road
Suite A310
Irwindale, CA 91706

Ph: 626-856-3400

Sanitation Districts of Los Angeles County - http://www.lacsd.org
The Sanitation Districts provide wastewater and solid waste management for over half the population of Los Angeles County and turn waste products into resources such as reclaimed water, energy, and recyclable materials.

1955 Workman Mill Road
Whittier, CA 90607
Ph: 562-699-7411 x2301

Santa Monica Mountains Conservancy - http://smmc.ca.gov/
The Santa Monica Mountains Conservancy helps to preserve over 55,000 acres of parkland in both wilderness and urban settings, and has improved more than 114 public recreational facilities throughout Southern California.

570 West Avenue Twenty-Six
Suite 100
Los Angeles, CA 90065
Ph: 323-221-8900

.
South Bay Economic Development Partnership - http://www.southbaypartnership.com
Notes: The South Bay Economic Development Partnership is a collaboration of business, labor, education, and government. Its primary goal is to plan an implement an economic development and marketing strategy designed to retain and create jobs and stimulate economic growth in the South Bay of Los Angeles County.

3858 Carson Street
Suite 110
Torrance, CA 90503
Ph: 310-792-0323

South Coast Air Quality Management District (AQMD) - http://www.aqmd.gov
AQMD is a regional government agency that seeks to achieve and maintain healthful air quality through a comprehensive program of research, regulations, enforcement, and communication. The AQMD covers Los Angeles and Orange Counties and parts of Riverside and San Bernardino Counties.

21865 E. Copley Drive
Diamond Bar, CA 91765
Ph: 800-CUT-SMOG

Southern California Earthquake Center (SCEC) - http://www.scec.org
Notes: The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to

end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.

3651 Trousdale Parkway
Suite 169
Los Angeles, CA 90089-0742
Ph: 213-740-5843

Southern California Association of Governments (SCAG) - http://www.scag.ca.gov
The Southern California Association of Governments functions as the Metropolitan Planning Organization for six counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. As the designated Metropolitan Planning Organization, the federal government mandates that SCAG research plans for transportation, growth management, hazardous waste management, and air quality.

818 W. Seventh Street12th Floor
Los Angeles, CA 90017
Ph: 213-236-1800

Western States Seismic Policy Council (WSSPC) - http://www.wsspc.org/home.html
WSSPC is a regional earthquake consortium funded mainly by FEMA. Its website is a great resource, with information clearly categorized - from policy to engineering to education.

125 California Avenue
Suite D201, #1
Palo Alto, CA 94306
Ph: 650-330-1101

Westside Economic Collaborative C/O Pacific Western Bank - http://www.westside-la.org
The Westside Economic Development Collaborative is the first Westside regional economic development corporation. The Westside EDC functions as an information gatherer and resource center, as well as a forum, through bringing business, government, and residents together to address issues affecting the region: Economic Diversity, Transportation, Housing, Workforce Training and Retraining, Lifelong Learning, Tourism, and Embracing Diversity.

120 Wilshire Boulevard
Santa Monica, CA 90401
Ph: 310-458-1521

State Resources

California Department of Transportation (CalTrans) http://www.dot.ca.gov/
CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. Alone and in partnership with Amtrak, Caltrans is also involved in the support of intercity passenger rail service in California.

120 S. Spring Street
Los Angeles, CA 90012
Ph: 213-897-3656

California Resources Agency – http://resources.ca.gov/
The California Resources Agency restores, protects and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration and respect for all the communities and interests involved.

1416 Ninth Street
Suite 1311
Sacramento, CA 95814
Ph: 916-653-5656

California Division of Forestry (CDF) – http://www.fire.ca.gov/php/index.php
The California Department of Forestry and Fire Protection protects over 31 million acres of California's privately-owned wildlands. CDF emphasizes the management and protection of California's natural resources.

210 W. San Jacinto
Perris CA 92570
Ph: 909-940-6900

California Division of Mines and Geology (DMG) – http://www.consrv.ca.gov
The California Geological Survey develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources.

801 K Street MS 12-30
Sacramento, CA 95814
Ph: 916-445-1825

California Environmental Resources Evaluation System (CERES) – http://ceres.ca.gov
CERES is an excellent website for access to environmental information and websites.

900 North St. Suite 250
Sacramento, Ca. 95814
Ph: 916-653-2238

California Department of Water Resources (DWR) – http://wwwdwr.water.ca.gov
The Department of Water Resources manages the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.

1416 9th Street
Sacramento, CA 95814
Ph: 916-653-6192

California Department of Conservation, Southern California Regional Office
http://www.consrv.ca.gov
The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources.

655 S. Hope Street #700
Los Angeles, CA 90017-2321
Ph: 213-239-0878

California Planning Information Network – http://www.calpin.ca.gov The Governor's Office of Planning and Research (OPR) publishes basic information on local planning agencies, known as the California Planners' Book of Lists. This local planning information is available on-line with new search capabilities and up-to-the- minute updates.

Governor's Office of Emergency Services (OES) - http://www.oes.ca.gov
The Governor's Office of Emergency Services coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.

P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911

State Fire Marshal (SFM) http://osfm.fire.ca.gov
The Office of the State Fire Marshal (SFM) supports the mission of the California Department of Forestry and Fire Protection (CDF) by focusing on fire prevention. SFM regulates buildings in which people live, controls substances that may, cause injuries, death, and destruction by fire; provides statewide direction for fire prevention within wild land areas; regulates hazardous liquid pipelines; reviews regulations and building standards; and trains and educates in fire protection methods and responsibilities.

1131 S Street
Sacramento, CA 95814
Ph: 916-445-8200

Local Resources

San Dimas Chamber of Commerce http://www.sandimaschamber.com
The Mission of the San Dimas Chamber of Commerce is to foster and promote growth of the business and professional community while enhancing the quality of life in San Dimas.

246 East Bonita Ave.
San Dimas, CA 91773
Ph:909.592.3818

Appendix B:

The Public Participation Process

Public participation is a mandatory, but essential component to successful strategic planning. A well-organized public participation process established relationships and strong communication lines where residents, local stakeholders, and emergency response providers can offer their specialized knowledge and experience to help prioritize mitigation actions.

The City of San Dimas Natural Hazards Mitigation Plan integrates a cross-section of public feedback throughout the planning process. To accomplish this goal, we developed a public participation process through three components:

1. Developing project Steering, Technical, and Advisory Committees comprised of knowledgeable individuals representative of the community.
2. Using historical data and interviews to target specialized knowledge from credible resources.
3. Conducting public forums to identify common concerns regarding hazard mitigation and discussing specific goals and actions of the mitigation plan.

Integrating public participation during the development of the San Dimas Natural Hazards Mitigation Plan has led to increased public awareness and a better understanding of the community's concerns. Through citizen involvement, the mitigation plan reflects community issues and ideas on mitigation opportunities and plan action items.

Steering Committee

Hazard mitigation in City of San Dimas is led by the Hazard Mitigation Steering Committee, which consists of representatives from various city departments, local business and community organizations, regional hazard management offices, and residents. Steering Committee members possess an understanding of how the community is structured and how residents, businesses, and the environment may be affected by natural hazard events. The Committee guided the overall development of the plan, and assisted in developing goals, identifying stakeholders, and sharing expertise to create a more comprehensive plan.

Project Steering Committee:

- City of San Dimas Administrative Services
- City of San Dimas Building and Safety Division
- City of San Dimas Community Development
- City of San Dimas Planning Commission
- City of San Dimas Public Safety Commission
- City of San Dimas Chamber of Commerce
- City of San Dimas Historical Society
- Bonita Unified School District
- Residents of the San Dimas Community
- Office of Disaster Management, Area D: Brenda Hunemiller, Coordinator

Meetings #1 and #2: January 15, 2004 and January 28, 2004 - *Developing Your City's Hazard Mitigation Plan*

The Los Angeles County Office of Emergency Management held these workshops for local cities to become more familiar with the Natural Hazard Mitigation Plan and its requirements. During these sessions, Area coordinators discussed the overall planning process and presented a general timeline to ensure completion.

A major component of this workshop was the definition of the goals and missions of the Plan. Feedback was considered from representatives from local cities, school districts, fire departments, and the State OES in order to reflect their concerns about natural hazards. The mission statement, goals, and objectives stated in the body of the Hazard Mitigation plan reflect the discussion that occurred during that meeting.

Protect Life and Property

- Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to losses from natural hazards.
- Reduce losses and repetitive damages for chronic hazard events while promoting insurance coverage for catastrophic hazards.
- Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventive measures for existing development in areas vulnerable to natural hazards.

Increase Public Awareness

- Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
- Provide informational items, partnership opportunities and funding resource information to assist in implementing mitigation activities.

Strengthen Partnerships

- Strengthen communication and coordinate participation among and within public agencies, residents, non profit organizations, business, and industry to gain a vested interest in the implementation of mitigation measures.
- Encourage and support leadership within the private sector, non-profit agencies and community based organizations to promote local hazard mitigation activities.

City Emergency Services

- Establish policy to ensure the importance of mitigation programs and projects for critical facilities, services, and infrastructure.
- Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.

- Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Environmental & Historical Preservation

- Balance land use planning with natural and manmade hazard mitigation to protect life, property and the environment.

Meeting #3: February 19, 2004 – *Area D General Meeting*

Area D of the Office of Disaster Management discussed its role as a resource and a guideline to its constituents during the Natural Hazard Mitigation Plan planning process. Several methods of assistance were discussed including presentations and briefings to City Councils, letters to City Managers emphasizing the need for such a plan, inclusion of school districts, utilities, fire, and public works representatives. The Area Coordinator also discussed the necessity of resolutions passed by City Councils to approve the creation of the plan, hiring consultants for plan development and methods for distributing County information to the cities.

Meeting #4: May 20, 2004 – *Area D General Meeting*
Considerations at this meeting included specific hazard templates and a general round table discussion to bring up specific issues cities were facing.

Meeting #5: October 6, 2004 – *Area D General Meeting*

This meeting was held to address any last minute concerns regarding the drafting and final submission of the Plan.

Meeting #6: October 19, 2004 – *Area D General Meeting*
Last minute preparations and issues were discussed before submission for the final deadline.

Technical Committee

A Technical Advisory Committee was formed to provide technical research and analysis and prepare the written plan. The series of meeting allowed the Technical Committee to review incremental materials and provide feedback based on their area of expertise and experience. This committee convened every two weeks, with approximately seven meetings.

Project Technical Committee:

- Ken Duran, Assistant City Manager, City of San Dimas
- Carl Flores, Battalion Chief, County of Los Angeles Fire Department
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Eric Beilstein, Superintendent, Building and Safety, City of San Dimas
- Joe Vacca, Associate Planner, City of San Dimas
- John Lee, Administrative Aide, City of San Dimas
- Lynn Kelly, Administrative Intern, City of San Dimas

Meeting #1: June 29, 2004 - *Identification of Hazards and Research Tasks*

During this introductory meeting, members of the Technical Committee reviewed the requirements of the Disaster Mitigation Act of 2000. Threatening hazards to San Dimas were identified as earthquakes, landslides, windstorms, floods, and wildfire. The Technical Committee drafted a general timeline for completion using FEMA's Crosswalk as a guide. Input from the team led to the delegation of research tasks for Sections 6 - 10. A Project Team would be responsible for the drafting and assembling of the final report.

Meeting #2: July 14, 2004 – *Hazard Assessment and Community Profile Review*

The Project team presented information from research on hazards and their associated risks. After reviewing the requirements of the Community Profile, potential resources were identified. Research responsibilities for Sections 1 – 5 were delegated within the Project Team.

Meeting #3: September 1, 2004 – *Drafting Action Items and Identifying Critical Facilities*

After the assignments from the last meeting were presented, the Technical Committee brainstormed and discussed a set of draft mitigation items for each hazard. These action items were built on specialized knowledge within the Committee and would be further defined by community input. The Committee identified current mitigation action items that have been implemented locally. There was also discussion regarding the difficulty of proper risk assessment.

Meeting #4: September 8, 2004

The Technical Committee refined the action items discussed during the previous meeting and developed evaluation criteria. After reviewing numerous samples from other local cities, a survey was drafted in order to incorporate resident feedback into the plan. The survey can be found in the public forum section of this appendix.

Meeting #5: September 15, 2004

At this meeting, additions to the mitigation action items were made in order to incorporate multi-hazard items.

Meeting #6: October 4, 2004
The Committee once again reviewed the mitigation action items altered by the Advisory Committee. Once finalized, the City Department Heads will be invited to comment.

Advisory Committee

An Advisory Committee was formed in order to coordinate input from experienced residents with specialized knowledge in specific areas. The main functions of the Advisory Committee were to provide feedback on mitigation items suggested by the Technical Committee, and to help guide a plan for implementation and monitoring.

Project Advisory Committee:

- Ken Duran, Assistant City Manger, City of San Dimas
- David Bratt, Planning Commission, City of San Dimas
- Neil Oedijans, Public Safety Commission, City of San Dimas
- Robert Anderson, Public Safety Commission, City of San Dimas
- Paul Rippins, City of San Dimas Historical Society
- Eileen Mullen, Bonita Unified School District
- Ed McKenzie, Community Action Team, County of LA Sheriff's Department
- Laura Nash, City of San Dimas Community at Large
- Scott Dilley, Chamber of Commerce, City of San Dimas

Meeting #1: September 29, 2004

This initial meeting of the Advisory Committee began with a general discussion of the requirements of the Plan, with a particular emphasis on the mitigation items. Members were asked to brainstorm potential actions. After a subsequent discussion of these ideas, the Advisory Committee then reviewed and commented on those mitigation items that had been developed by the Technical Committee.

Meeting #2: October 18, 2004

This follow up meeting provided another opportunity for review of the Hazard Mitigation Action Items. The implementation and monitoring of the NHMP was also discussed and it was determined that it would be beneficial for the Public Safety Commission to assist in implementing this plan.

Public Forums

The City of San Dimas staff facilitated various public forums to gather comments and ideas from citizens about mitigation planning and priorities for mitigation plan goals. The Natural Hazard Mitigation Plan was routinely briefed at City Council meetings, where residents were invited to comment. In addition, residents were encouraged to provide insight on natural hazard concerns via a survey that was distributed throughout City Hall, Senior Center, public library, and other community buildings. The survey was also available online at the City's website http://www.cityofsandimas.com. The data gathered from these forums was used to tailor the mitigation action items to best suit the City's needs. The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make the City of San Dimas more disaster resilient.

Meeting #1: February 7, 2004 – *Public Safety Commission Presentation*

This Commission meeting included updates on several key items of interest affecting the City. One objective of this presentation was to brief the Public Safety Commission on the background, goals, and requirements for the City of San Dimas and the Natural Hazard Mitigation Plan.

Meeting #2: February 24, 2004 – *City Council Meeting*

Council Members and residents were briefed on the Natural Hazard Mitigation Plan components. The background of the Disaster Mitigation Act of 2000 was supplied in order to provide insight on our requirements. Other items of discussion included the overall planning process, risk assessment, mitigation strategies, maintenance, and review. Resolution 04-08 was adopted in support of the development of a Natural Hazard Mitigation Plan in accordance with the Federal Disaster Mitigation Act of 2000.

Meeting #3: August 5, 2004 – *Presentation at the Chamber of Commerce Breakfast*

The City of San Dimas Chamber of Commerce and various residents who attended this breakfast updated on the progress of the Hazard Plan and invited to contribute suggestions.

Meeting #4: September 28, 2004 – *City Council Meeting*

City Council Members and attending residents were informed of the tremendous amount of progress made in the previous months. Items open to discussion included: mission and goals, the organization of the Technical and Advisory Committees, community profile, identification of hazards, historical research, public input through surveys, mitigation action items, and evaluation criteria.

Meeting #5: November 9, 2004 – *City Council Meeting*

The final draft of the Natural Hazard Mitigation Plan was presented to City Council and attending residents. The presentation included a detailed outline of required elements of the plan, as well as background information, and mitigation action items. City Council passed the NHMP through minutes and recommended that it be forwarded to the State of California Office of Emergency Services and the Federal Emergency Management Agency. A copy of the resolution is attached.

Other Venues for Input

The Frontier – An open invitation for public input in our Summer and Fall editions of the City's quarterly newsletter was welcomed feedback from San Dimas residents concerning the plan.

Surveys – The attached survey was distributed to various civic centers throughout the City, including the Library, Senior Center, City Hall, and website in order to incorporate residents' ideas on hazard mitigation.

City of San Dimas Natural Hazard Mitigation and Preparedness Questionnaire

This questionnaire is designed to help the City of San Dimas Natural Hazard Mitigation Plan Steering Committee identify the community's concerns about natural hazards and to better understand community needs in reducing risk and loss from such hazards. The questionnaire should be completed by an adult, preferably the homeowner or the head of the household. Please, take a few moments to complete this questionnaire. All individual responses are strictly confidential, and are for research purposes only. Thank you.

1. How concerned are you about the following disasters affecting your community? Please give each hazard a priority rating as follows: ***0 = Not Concerned; 1 = Somewhat Concerned; 2 = Moderately Concerned; 3 = Very Concerned***

Floods	_____	Landslide	_____
High Winds	_____	Earthquake	_____
Wild Fire	_____		

2. Natural disasters can have a significant impact on a community, but planning for these events can help lessen the impact. The following statements will help us determine community priorities for planning the mitigation of those hazards. Please tell us how important each one is to you.

Statement	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property					
Protecting critical facilities (hospitals, police and fire departments, transportation networks)					
Preventing development in hazard areas					
Protecting the natural environment					
Protecting historical and cultural landmarks					
Promoting cooperation among public agencies, citizens, non-profit organizations and businesses					
Protecting and reducing damage to utilities					
Strengthening emergency services					

3. Please check the box that best represents your opinion of the following strategies to reduce risk and loss associated with natural disasters.

Community Strategies	Agree	Neutral	Disagree	Not Sure
I support a regulatory approach to reducing risk.				
If available, I would attend workshops on how to reduce the risk of a disaster in my home.				
I support policies that restrict development in areas subject to natural hazards.				
I support the use of local tax dollars to reduce risks and losses from natural disasters.				
I support protecting historical and cultural structures.				
I would be willing to make investments to make my home more disaster-resistant.				
I support steps to safeguard the local economy following a disaster event.				

Appendix C: Evaluation of Natural Hazard Mitigation Projects

There are several tools that can be used to rank and select proposed activities. One of the most common tools used is a matrix. A matrix allowed the City to rank possible activities based on a predetermined set of criteria using a simple rating scale. The matrix was not the focus of the final recommendations for each mitigation project, but has been used to stimulate conversation about the pros and cons of each activity, and helped narrow the list of activities that The Steering Committee will ultimately select from.

The Steering Committee has identified several criteria that it has used to evaluate a set of activities for each hazard. The group selected the criteria based on the values, policies, and environmental/economic realities of the community. In addition to this set of criteria, each activity must also be politically feasible and meet all federal, state, and local regulations. The following is the set of criteria that the Committee has considered:

1. Cost-Effectiveness
2. Overall Affordability
3. Technical Feasibility
4. Environmental Impacts
5. Reduction of Risk / Addresses the Problem

An important factor to consider is the overall cost of each activity. While this should not be the single, deciding factor for all projects, it is important to recognize that a large portion of City resources have been earmarked for other functions. As funding and grants become available to pursue mitigation activities, the City of San Dimas will be able to commit to more tasks.

Most of the hazard mitigation projects that have been included in this plan have been evaluated on the basis of their affordability. Many activities that the City is currently undertaking have many benefits outside the realm of hazard mitigation, and will continue, despite possible perceived costliness. Others, such as public education programs, are relatively low in cost, and did not require further cost evaluation.

The Steering Committee has also recognized the importance of benefit-cost analyses on selected projects to compare possible mitigation activities. If the benefits of an action are less than the costs, the Committee has the options of assigning the activity a lower ranking, re-designing the activity, or abandoning that activity altogether. The process of cost-benefit analysis is presented in greater detail later in this appendix.

Unfortunately, it is not practical to perform a benefit-cost analysis for some proposed mitigation activities. For example, it is not realistic to evaluate the costs and benefits of an elementary school poster contest to raise awareness of hazards associated with earthquakes. It is also difficult to quantify the benefits of a community adopting stricter building codes to prevent flood damage. However, large mitigation projects that require federal or state funding will require a benefit-cost analysis as part of the application for funding. The Steering Committee has chosen the following five implementation initiatives to evaluate using benefit-cost analysis:

- *Develop an evacuation plan for Sycamore Canyon Equestrian Center.*

- *Include a USGS layer on the GIS system to maintain a database of properties subject to landslide liquefaction.*
- *Develop an Action Plan to address the risk of isolation for residents in San Dimas Canyon because evacuation routes may be blocked by landslides.*
- *Evaluate the potential for upgrade or replacement of identified bridge crossings.*
- *Evaluate the potential for street intersection upgrades at Sycamore Canyon Road and San Dimas Canyon Road.*

These projects were selected for benefit-cost analysis because of the quantifiable nature of their costs and benefits, their priority within the City, and the feasibility of implementation. The capability of this type of analysis for these projects is discussed below.

Benefit-cost analysis is a key mechanism used by the state Office of Emergency Services (OES), FEMA, and other agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act. This appendix outlines several approaches for conducting economic analysis of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from the FEMA's *Report on Costs and Benefits of Natural Hazard Mitigation.*

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating natural hazard mitigation provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Evaluating mitigation projects is a complex and difficult task and is influenced by many variables. Natural disasters do not discriminate. They affect all segments of the communities, including individuals, businesses, and public services.

Also, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are difficult to quantify in dollars. Finally, many of the impacts of such events produce ripple-effects throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit-cost comparison. Otherwise, the decision to pursue or not pursue mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are Some Economic Analysis Approaches for Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit-cost analysis and cost-effectiveness analysis. The distinction between the two methods is the way in which the relative costs and benefits are measured. Additionally, there are varying approaches to assessing the value

of mitigation for public sector and private sector activities.

Benefit-Cost Analysis (BCA)
Benefit-cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit-cost analysis for a mitigation activity can assist the City in determining whether a project is worth undertaking now, in order to avoid disaster related damages later. BCA is based on calculating the frequency and severity of a hazard, avoided future damages, costs of the project, and risk.

In BCA, all costs and benefits are evaluated in terms of dollars, and a net benefit-cost ratio is computed to determine whether a project should be implemented (i.e., if net benefits exceed net costs, the project is worth pursuing). A project must have a benefit-cost ratio greater than 1 in order to be funded by FEMA.

Cost-Effectiveness Analysis
Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome.

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. As evident by many of the City's mitigation items, some benefits cannot be easily monetized, but still affect the public in profound ways.

Private sector mitigation projects may occur on the basis of one of two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. In order to lessen the impact of an unfunded mandate, a private or public organization has alternatives to consider, such as cost-sharing from an additional public agency, or evaluating other feasible alternatives to initiate the most cost-effective hazard mitigation project.

How Is an Economic Analysis Conducted?

Benefit-cost analysis and cost-effectiveness analysis are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating alternative mitigation activities is outlined below.

1. Identify the Alternatives. Alternatives for reducing risk from natural hazards in San Dimas include structural projects to enhance disaster resistance, education and outreach, infrastructure replacement, collaboration with the private sector, and many others. Different mitigation projects can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits. Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate alternative. The four main components of benefit-cost analysis are:

a) **Project costs.** This includes both initial project development costs, and repair and

operating costs of maintaining projects over time. In addition, costs of a project should include any displacement, economic, environmental, or other opportunity costs resulting from the development. The latter set is not easily quantified, but sensitivity analysis can predict various scenarios and their outcomes.

b) **Overall benefits.** Projecting the benefits or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which are often uncertain. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. Future tax structures and rates must also be included. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

c) **Determine the correct discount rate.** Determination of the discount rate may be the risk-free cost of capital, but it can also include a risk premium, and adjustments for inflation. For FEMA grant applications, a discount rate of 7% is required.

d) **Determine the appropriate time horizon.** This involves predicting the effective life of a project.

3. Analyze and Rank the Alternatives. Once costs and benefits have been quantified, economic analysis tools can rank the alternatives. Two methods for determining the best alternative given varying costs and benefits include net present value and internal rate of return.

a) **Net present value.** Net present value is the value of the expected future returns of an investment minus the value of expected future cost expressed in today's dollars. If the net present value is greater than the project costs, the project may be determined feasible for implementation.

b) **Internal Rate of Return.** Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects.

How are Benefits of Mitigation Calculated?

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. While evaluating the economic feasibility of mitigation projects, the City has considered reductions in physical damages, financial losses, and loss of life such as:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

- Major and minor injuries avoided
- Loss of life avoided

These parameters can be estimated using observed prices, costs, past hazard event reports, and engineering data. In a benefit-cost analysis done for the City, the damages and losses should only include those that will be absorbed by the City. If a more utilitarian approach was utilized, the entire range of costs and benefits could be included.

One difficulty is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. This is often compensated for during sensitivity analysis. In this case, the City of San Dimas can provide worse, best, and mean case scenarios to assess the potential for mitigation.

Equally difficult is assessing the probability that a hazard will occur. In the case of flooding, the City used data from previous floods to determine the overall frequency of various floods. By using BCA modules or HAZUS, this can be correctly incorporated into a benefit-cost analysis.

Additional Costs from Natural Hazards
Property owners, including the City, should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These indirect effects can have a very direct effect on the economic value of property. They can include changes in the following:

- Availability and prices of resources
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Infrastructure
- Regional exports and imports
- Local, state, and federal regulations
- Insurance availability and rates

Changes in the resources listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. The City of San Dimas understands the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Using Benefit-Costs Analysis in San Dimas

As stated earlier, it is a necessity to stress the importance of benefit-cost analysis for certain mitigation activities that the City may wish to pursue. Not only does this provide a basis of comparison for seemingly incomparable projects, but it is an obligatory component for all federal and state mitigation funding opportunities.

The elements of these analyses are derived from the information calculated in the risk assessment worksheets. They take into account both the property and the life value of everything within each hazard area. Conducting a BCA will assist the City in quantifying the overall benefits of potential mitigation projects, allowing comparison between them. While benefit-cost analysis is an essential part of the evaluation process, the criteria mentioned in the beginning of this appendix also play a critical role in the final selection of projects.

This section provides an overview on the benefits of conducting this type of analysis for the above-mentioned projects.

Develop an evacuation plan for Sycamore Canyon Equestrian Center.
Last winter, the City of San Dimas experienced unusually heavy precipitation, leading to increased incidences of flooding. Certain areas of the City, such as the Sycamore Canyon area, were at higher risk of property damage and isolation. By conducting a BCA, the City will be able to demonstrate whether this project is cost-effective in mitigating damages from a flood or landslide. If determined not to be cost-effective, the City will lower the priority of completing the evacuation plan.

Include a USGS layer on the GIS system to maintain a database of properties subject to landslide liquefaction.
The new GIS system has already proved to be a useful tool in planning, building, public works, and administration. The City is considering the purchase of a variety of other layers for the system, and benefit-cost analysis is one criterion to determine the overall effectiveness of a USGS layer compared to other alternatives.

Develop an Action Plan to address the risk of isolation for residents in San Dimas Canyon because evacuation routes may be blocked by landslides.
The unusually heavy precipitation last winter severely limited the ability of residents in the San Dimas Canyon area to carry on routine functions. Several residents are partially isolated due to debris and decay of local roads. A benefit-cost analysis of this project has determined that this implementation initiative is cost-effective, and the City has placed it has a higher priority. In the case of an emergency, such as a wildfire or another flood, this mitigation item can lower the risk of injury and/or death. The necessity of this project was the overall deciding factor of implementation, however BCA further emphasized its efficacy.

Evaluate the potential for upgrade or replacement of identified bridge crossings.
After determining the costs and benefits for the option of upgrading specific bridge crossings versus the complete replacement of these problem areas, the City can compare the results to determine the more efficient and effective procedure.

Evaluate the potential for street intersection upgrades at Sycamore Canyon Road and San Dimas Canyon Road.
The City can use this tool to help determine the priority of this project versus the abovementioned projects. While this action is necessary at some point in the near future, the City may allocate funds more appropriately to more effective projects.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit-cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Many communities are looking towards developing multi-objective projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies For Evaluating The Socio-Economic Consequences Of Large Earthquakes, Task 7.2 Economic Impact Analysis*, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997.

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation Projects, Riverine Flood, Version 1.05*, Hazard Mitigation Economics Inc., 1996.

Federal Emergency Management Agency Report on Costs and Benefits of Natural Hazard Mitigation. Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in The City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch*, October 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olson Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000).

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings, Volumes 1 & 2*, Federal Emergency Management Agency, FEMA, Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program*, Volume 3: Seismic Hazard Mitigation Projects, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model, Volume 1*, Federal Emergency Management Agency, FEMA, Publication Number 255, 1994.

Appendix D Acronyms

Federal Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ATC	Applied Technology Council
BCA	benefit-cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CRS	Community Rating System
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United States, Department of)
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard Mitigation Team
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as "409 Plan")
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
SBA	Small Business Administration

SEAO	Structural Engineers Association of Oregon
SHMO	State Hazard Mitigation Officer
TOR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

California Acronyms

A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
ARC	American Red Cross
ARP	Accidental Risk Prevention
BSA	California Bureau of State Audits
CAER	Community Awareness & Emergency Response
CalARP	California Accidental Release Prevention
CalBO	California Building Officials
CalEPA	California Environmental Protection Agency
CalREP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
CalTRANS	California Department of Transportation
CBO	Community Based Organization
CDF	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEPEC	California Earthquake Prediction Evaluation Council
CESRS	California Emergency Services Radio System
CHIP	California Hazardous Identification Program
CHP	California Highway Patrol
CLETS	California Law Enforcement Telecommunications System
CSTI	California Specialized Training Institute
CUEA	California Utilities Emergency Association
CUPA	Certified Unified Program Agency
DAD	Disaster Assistance Division (of the state Office of Emergency Svcs)
DFO	Disaster Field Office
DGS	California Department of General Services
DHSRHB	California Department of Health Services, Radiological Health Branch
DO	Duty Officer

DOC	Department Operations Center
DOE	Department of Energy (U.S.)
DOF	California Department of Finance
DOJ	California Department of Justice
DPA	California Department of Personnel Administration
DPIG	Disaster Preparedness Improvement Grant
DR	Disaster Response
DSA	Division of the State Architect
DSR	Damage Survey Report
DSW	Disaster Service Worker
DWR	California Department of Water Resources
EAS	Emergency Alerting System
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EMA	Emergency Management Assistance
EMI	Emergency Management Institute
EMMA	Emergency Managers Mutual Aid
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency (U.S.)
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ESC	Emergency Services Coordinator
FDAA	Federal Disaster Assistance Administration
FEAT	Governor's Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FIR	Final Inspection Reports
FMA	Flood Management Assistance
GIS	Geographical Information System
HAZMAT	Hazardous Materials
HAZUS	Hazards United States (an earthquake damage assessment prediction tool)
HEICS	Hospital Emergency Incident Command System
HMEP	Hazardous Materials Emergency Preparedness
HMGP	Hazard Mitigation Grant Program
IDE	Initial Damage Estimate
IFG	Individual & Family Grant (program)
IRG	Incident Response Geographic Information System
IPA	Information and Public Affairs (of state Office of Emergency Services)
LEPC	Local Emergency Planning Committee
MHID	Multihazard Identification
NEMIS	National Emergency Management Information System
NFIP	National Flood Insurance Program

NOAA	National Oceanic and Atmospheric Association
NPP	Nuclear Power Plant
NSF	National Science Foundation
NWS	National Weather Service
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OEP	Office of Emergency Planning
OES	California Governor's Office of Emergency Services
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PDA	Preliminary Damage Assessment
PIO	Public Information Office
POST	Police Officer Standards and Training
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
RA	Regional Administrator (OES)
RAMP	Regional Assessment of Mitigation Priorities
RAPID	Railroad Accident Prevention & Immediate Deployment
RDMHC	Regional Disaster Medical Health Coordinator
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information
RIMS	Response Information Management System
RMP	Risk Management Plan
RRT	Regional Response Team
SARA	Superfund Amendments & Reauthorization Act
SAVP	Safety Assessment Volunteer Program
SBA	Small Business Administration
SCO	California State Controller's Office
SEMS	Standardized Emergency Management System
SEPIC	State Emergency Public Information Committee
SLA	State and Local Assistance
SOP	Standard Operating Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TTT	Train the Trainer
UPA	Unified Program Account
UPS	Uninterrupted Power Source
USAR	Urban Search and Rescue
USGS	United States Geological Survey
WC	California State Warning Center
WAN	Wide Area Network

Appendix E:
Glossary

Acceleration	The rate of change of velocity with respect to time. Acceleration due to gravity at the earth's surface is 9.8 meters per second squared. That means that every second that something falls toward the surface of earth its velocity increases by 9.8 meters per second.
Asset	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.
Base Flood	Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.
Base Flood Elevation (BFE)	Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.
Bedrock	The solid rock that underlies loose material, such as soil, sand, clay, or gravel.
Building	A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.
Coastal High Hazard Area	Area, usually along an open coast, bay, or inlet, that is subject to inundation by storm surge and, in some instances, wave action caused by storms or seismic sources.
Coastal Zones	The area along the shore where the ocean meets the land as the surface of the land rises above the ocean. This land/water interface includes barrier islands, estuaries, beaches, coastal wetlands, and land areas having direct drainage to the ocean.
Community Rating System (CRS)	An NFIP program that provides incentives for NFIP communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of policyholders in these communities are reduced.
Contour	A line of equal ground elevation on a topographic (contour) map.

Critical Facility	Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.
Debris	The scattered remains of assets broken or destroyed in a hazard event. Debris caused by a wind or water hazard event can cause additional damage to other assets.
Displacement Time	The average time (in days) which the building's occupants typically must operate from a temporary location while repairs are made to the original building due to damages resulting from a hazard event.
Duration	How long a hazard event lasts.
Earthquake	A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.
Erosion	Wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm or over a period of years, through the action of wind, water, or other geologic processes.
Erosion Hazard Area	Area anticipated to be lost to shoreline retreat over a given period of time. The projected inland extent of the area is measured by multiplying the average annual long-term recession rate by the number of years desired.
Essential Facility	Elements that are important to ensure a full recovery of a community or state following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.
Extratropical Cyclone	Cyclonic storm events like Nor'easters and severe winter low-pressure systems. Both West and East coasts can experience these non-tropical storms that produce gale-force winds and precipitation in the form of heavy rain or snow. These cyclonic storms, commonly called Nor'easters on the East Coast because of the direction of the storm winds, can last for several days and can be very large – 1,000-mile wide storms are not uncommon.
Fault	A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.
Federal Emergency Management Agency (FEMA)	Independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.

Fire Potential Index (FPI)	Developed by USGS and USFS to assess and map fire hazard potential over broad areas. Based on such geographic information, national policy makers and on-the-ground fire managers established priorities for prevention activities in the defined area to reduce the risk of managed and wildfire ignition and spread. Prediction of fire hazard shortens the time between fire ignition and initial attack by enabling fire managers to pre-allocate and stage suppression forces to high fire risk areas.
Flash Flood	A flood event occurring with little or no warning where water levels rise at an extremely fast rate.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.
Flood Depth	Height of the flood water surface above the ground surface.
Flood Elevation	Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.
Flood Hazard Area	The area shown to be inundated by a flood of a given magnitude on a map.
Flood Insurance Rate Map (FIRM)	Map of a community, prepared by the Federal Emergency Management Agency, that shows both the special flood hazard areas and the risk premium zones applicable to the community.
Flood Insurance Study (FIS)	A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.
Floodplain	Any land area, including watercourse, susceptible to partial or complete inundation by water from any source.
Frequency	A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.
Fujita Scale of Tornado Intensity	Rates tornadoes with numeric values from F0 to F5 based on tornado windspeed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while and F5 indicated severe damage sustained.

Functional Downtime	The average time (in days) during which a function (business or service) is unable to provide its services due to a hazard event.
Geographic Area Impacted	The physical area in which the effects of the hazard are experienced.
Geographic Information Systems (GIS)	A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.
Ground Motion	The vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions
Hazard	A source of potential danger or adverse condition. Hazards in this how to series will include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
Hazard Event	A specific occurrence of a particular type of hazard.
Hazard Identification	The process of identifying hazards that threaten an area.
Hazard Mitigation	Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.
Hazard Profile	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
HAZUS (Hazards U.S.)	A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.
Hurricane	An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74-miles-per-hour or more and blow in a large spiral around a relatively calm center or "eye." Hurricanes develop over the north Atlantic Ocean, northeast Pacific Ocean, or the south Pacific Ocean east of 160°E longitude. Hurricane circulation is counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Hydrology	The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.
Infrastructure	Refers to the public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, drydocks, piers and regional dams.
Intensity	A measure of the effects of a hazard event at a particular place.
Landslide	Downward movement of a slope and materials under the force of gravity.
Lateral Spreads	Develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies in a seismic event. The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.
Liquefaction	Results when the soil supporting structures liquefies. This can cause structures to tip and topple.
Lowest Floor	Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.
Magnitude	A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.
Mitigation Plan	A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the state and includes a description of actions to minimize future vulnerability to hazards.
National Flood Insurance Program (NFIP)	Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 CFR §60.3.
National Geodetic Vertical Datum of 1929 (NGVD)	Datum established in 1929 and used in the NFIP as a basis for measuring flood, ground, and structural elevations, previously referred to as Sea Level Datum or Mean Sea Level. The Base Flood Elevations shown on most of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency are referenced to NGVD.

National Weather Service (NWS)	Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.
Outflow	Follows water inundation creating strong currents that rip at structures and pound them with debris, and erode beaches and coastal structures.
Planimetric	Describes maps that indicate only man-made features like buildings.
Planning	The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.
Probability	A statistical measure of the likelihood that a hazard event will occur.
Recurrence Interval	The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.
Repetitive Loss Property	A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.
Replacement Value	The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.
Richter Scale	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
Risk	The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.
Riverine	Of or produced by a river.
Scale	A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.
Scarp	A steep slope.
Scour	Removal of soil or fill material by the flow of flood waters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

Seismicity	Describes the likelihood of an area being subject to earthquakes.
Special Flood Hazard Area (SFHA)	An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designations that include the letter A or V.
Stafford Act	The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.
State Hazard Mitigation Officer (SHMO)	The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and postdisaster mitigation activities.
Storm Surge	Rise in the water surface above normal water level on the open coast due to the action of wind stress and atmospheric pressure on the water surface.
Structure	Something constructed. (See also Building)
Substantial Damage	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage.
Super Typhoon	A typhoon with maximum sustained winds of 150 mph or more.
Surface Faulting	The differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.
Tectonic Plate	Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.
Topographic	Characterizes maps that show natural features and indicate the physical shape of the land using contour lines. These maps may also include manmade features.
Tornado	A violently rotating column of air extending from a thunderstorm to the ground.
Tropical Cyclone	A generic term for a cyclonic, low-pressure system over tropical or subtropical waters.

Tropical Depression	A tropical cyclone with maximum sustained winds of less than 39 mph.
Tropical Storm	A tropical cyclone with maximum sustained winds greater than 39 mph and less than 74 mph.
Typhoon	A special category of tropical cyclone peculiar to the western North Pacific Basin, frequently affecting areas in the vicinity of Guam and the North Mariana Islands. Typhoons whose maximum sustained winds attain or exceed 150 mph are called super typhoons.
Vulnerability	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.
Vulnerability Assessment	The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.
Water Displacement	When a large mass of earth on the ocean bottom sinks or uplifts, the column of water directly above it is displaced, forming the tsunami wave. The rate of displacement, motion of the ocean floor at the epicenter, the amount of displacement of the rupture zone, and the depth of water above the rupture zone all contribute to the intensity of the tsunami.
Wave Run-up	The height that the wave extends up to on steep shorelines, measured above a reference level (the normal height of the sea, corrected to the state of the tide at the time of wave arrival).
Wildfire	An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.
Zone	A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Appendix F Risk Assessment Worksheets

City of San Dimas Risk Assessment: Earthquakes									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Community	# in Hazard Area	% in Hazard Area	$ in Community	$ in Hazard Area	% in Hazard Area	# in Community	# in Hazard Area	% in Hazard Area
Residential	9270	9270	100%	3.7 billion	3.7 billion	100%	34980	34980	100%
Commercial	268	268	100%	316 million	316 million	100%	NA	NA	NA
Industrial	120	120	100%	189 million	189 million	100%	NA	NA	NA
Religious / Non-Profit	10	10	100%	18 million	18 million	100%	NA	NA	NA
Government	2	2	100%	16 million	16 million	100%	NA	NA	NA
Education	3	3	100%	NA	NA	100%	NA	NA	NA
Utilities	NA	NA	NA	NA	NA	NA	NA	NA	NA
Agricultural	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9673	9673	100%	4.24 billion	4.24 billion	100%			

Appendix F Risk Assessment Worksheets

City of San Dimas Risk Assessment: Landslides									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Community	# in Hazard Area	% in Hazard Area	$ in Community	$ in Hazard Area	% in Hazard Area	# in Community	# in Hazard Area	% in Hazard Area
Residential	9270	100	1%	3.7 billion	40 million	1%	34980	300	1%
Commercial	268	0	0%	316 million	0	0%	NA	NA	NA
Industrial	120	0	0%	189 million	0	0%	NA	NA	NA
Religious / Non-Profit	10	0	0%	18 million	0	0%	NA	NA	NA
Government	2	0	0%	16 million	0	0%	NA	NA	NA
Education	3	0	0%	NA	0	0%	NA	NA	NA
Utilities	NA	NA	NA	NA	NA	NA	NA	NA	NA
Agricultural	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9673	100		4.24 billion	40 million				

Appendix F Risk Assessment Worksheets

City of San Dimas Risk Assessment: Flood									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Community	# in Hazard Area	% in Hazard Area	$ in Community	$ in Hazard Area	% in Hazard Area	# in Community	# in Hazard Area	% in Hazard Area
Residential	9270	30	0.3%	3.7 billion	12 million	0.3%	34980	90	0.3%
Commercial	268	0	0%	316 million	0	0%	NA	NA	NA
Industrial	120	0	0%	189 million	0	0%	NA	NA	NA
Religious / Non-Profit	10	0	0%	18 million	0	0%	NA	NA	NA
Government	2	0	0%	16 million	0	0%	NA	NA	NA
Education	3	0	0%	NA	NA	NA	NA	NA	NA
Utilities	NA	NA	NA	NA	NA	NA	NA	NA	NA
Agricultural	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9673	30		4.24 billion	12 million				

Appendix F Risk Assessment Worksheets

City of San Dimas Risk Assessment: Wild Fire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Community	# in Hazard Area	% in Hazard Area	$ in Community	$ in Hazard Area	% in Hazard Area	# in Community	# in Hazard Area	% in Hazard Area
Residential	9270	1390	15%	3.7 billion	555 million	15%	34980	5200	15%
Commercial	268	0	0%	316 million	0	0%	NA	NA	NA
Industrial	120	0	0%	189 million	0	0%	NA	NA	NA
Religious / Non-Profit	10	0	0%	18 million	0	0%	NA	NA	NA
Government	2	0	0%	16 million	0	0%	NA	NA	NA
Education	3	0	0%	NA	NA	NA	NA	NA	NA
Utilities	NA	NA	NA	NA	NA	NA	NA	NA	NA
Agricultural	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9673	1390		4.24 billion	555 million				

Appendix F Risk Assessment Worksheets

City of San Dimas Risk Assessment: Windstorm									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Community	# in Hazard Area	% in Hazard Area	$ in Community	$ in Hazard Area	% in Hazard Area	# in Community	# in Hazard Area	% in Hazard Area
Residential	9270	3245	35%	3.7 billion	1.3 billion	35%	34980	12243	35%
Commercial	268	13	5%	316 million	15.8 million	5%	NA	NA	NA
Industrial	120	6	5%	189 million	9.45 million	5%	NA	NA	NA
Religious / Non-Profit	10	1	10%	18 million	1.8 million	10%	NA	NA	NA
Government	2	0	0%	16 million	0	0%	NA	NA	NA
Education	3	0	0%	NA	0	0%	NA	NA	NA
Utilities	NA	NA	NA	NA	NA	NA	NA	NA	NA
Agricultural	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9673	3265		4.24 billion	1.33 billion				